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UNIVERSITY OF ALBERTA

PINUS CONTORTA COMMUNITY DYNAMICS IN BANFF AND JASPER NATIONAL PARKS

BY ©

JOHN JACOB STADT

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Master of Science in Plant Ecology.

DEPARTMENT OF BOTANY

Edmonton, Alberta
Spring, 1993

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UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled ***Pinus contorta* community dynamics in Banff and Jasper National Parks** submitted by John Jacob Stadt in partial fulfilment of the requirements for the degree of **Master of Science**.

Mark R.T. Dale

Date April 13, 1993

ABSTRACT

The objectives of this study were to examine overstorey and understorey dynamics over a 22 year period in *Pinus contorta* dominated communities in Banff and Jasper National Parks, and to attempt to relate differences in community dynamics at different stands to site specific factors such as moisture regime. Further objectives were to evaluate the ability of permanent plots, configured in 400 quadrat, 1 hectare modules, to document both stand and patch dynamic changes and to asses the potential of permanent reference stands as ecological monitoring stations for documenting temporal changes in the structure and composition of mountain forest ecosystems.

Four 1 ha plots, 100 × 100 m, and divided into 400 5 × 5 m quadrats, were established by R. Hnatiuk in 1967 following an extensive survey of *Pinus contorta* forests in Banff and Jasper National Parks. The four plots represented the three moisture regime classes that had resulted from a classification of *Pinus contorta* stands in his extensive survey. The Xeric class stand was established in the Montane ecoregion and the Mesic stand in the lower Subalpine ecoregion. Two Moist class stands were established; one in the Montane ecoregion and one in the upper Subalpine ecoregion. The sites were inventoried for tree density, diameter and cover in the overstorey stratum, and for vascular and bryoid frequency and cover in the understorey strata. The sites were re-established and re-inventoried in 1989 by the author.

Despite extensive tree mortality in the Xeric and Mesic plots, the stands remained dominated by *Pinus contorta* as conditions were unfavourable (too dry) for spruce and fir recruitment. However fir and/or spruce recruitment was abundant in the two Moist plots and these species became increasingly larger components of the tree canopy indicating that these stands are seral to communities dominated by mixtures of *Pinus*, *Picea*, and *Abies*.

Understorey dynamics was characterized by large increases in vascular species cover in the three lower elevation sites and by large bryoid cover increases at all four sites. However, the species composition and structure of the four sites was more stable over the interval.

The overstorey and understorey dynamics were influenced by a complex range of factors including moisture regime, elevation, site history, tree density, and ungulate populations. The prevalence of site-specific influences on community dynamics indicates the importance of the use of permanent reference stands in studying changes in mountain forest ecosystems.

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CHAPTER 1. INTRODUCTION

1.1 SUCCESSION IN PLANT COMMUNITIES

The modern understanding that plant communities are dynamic and change over time can be traced to Clements (1916). The concept of "succession", where an initial pioneering community gives way to succeeding plant communities until an equilibrium or climax community finally stabilizes or a new disturbance causes the process to repeat itself again, has been of great interest to ecologists, managers of parks, and foresters.

The temporal nature of succession, with time scales of between fifty and five hundred years not being uncommon, makes succession difficult to study. Theories abound, but few of them are based on rigorous field studies and there has been little agreement on the mechanism of how succession takes place. The concept of vegetation "climax" has been even more controversial among ecologists and the range of opinions more diverse. Although this thesis will not directly investigate the merits of various mechanisms of succession and vegetation climax, these concepts are important to the thesis and therefore should be understood.

While plant communities were described as early as 300 BC by Theophrastus, and the notion of community dynamics was discussed by Buffon in 1742, it was F.E. Clements with his exhaustive studies (1916, 1936) who brought the concept of succession into general acceptance. Clements recognized three major classes of vegetation in North America and subdivided each of these into smaller climax formations. He believed that the major determining factor for a particular climax formation (which for him included all the pre-climax successional stages) was climate. Clements believed that a particular climax community could be thought of as an organism. After a major disturbance, which could be considered a wounding of the climax community, the successional process followed a determined path in the "healing" of the community (Langford and Buell 1969). Clements (1916) thus regarded the climax as a super-organism, and succession as developmental ontogeny that followed repeatable patterns after perturbations. These rather deterministic elements of what is now known as the organismic theory of succession have been largely rejected (Langford and Buell 1969). More recently, however, others have continued the analysis of whole community properties during succession (Odum 1969, Drury and Nisbet 1973, Horn 1976, Connell and Slatyer 1977).

Individualistic approaches to vegetation succession and plant community structure have been advanced in response to Clementsian organismic theory (Gleason 1926, Whittaker 1967, Crawley 1986). Here, succession is viewed in the context of the adaptations of individual species independent of any transcendent properties of the whole community and thus emphasizes random elements of species immigration and establishment and frequent disturbance, while denying the determinism and directedness of succession as defined by Clements (Crawley 1986). Drury and Nisbet (1973) suggested that specific characteristics of individual species, such as rate of growth, survivability, and colonizing abilities, are the important factors in the successional patterns we see and thus they believe that a comprehensive theory of succession should be sought at the individual or cellular level and not in the emergent properties of communities.

Connell and Slatyer (1977) described and evaluated three possible successional mechanisms by which colonizing species are replaced by other species. The first mechanism is Clements' facilitation model where later species can become established and grow only after earlier ones have suitably modified the conditions. Their evidence indicated that this mechanism only occurs in primary succession on newly exposed surfaces and not in secondary succession. The second proposed mechanism, the tolerance model, states that later successional species will be those able to tolerate lower levels of resources than earlier ones. For example, in forest succession each species is able to tolerate deeper shade than the previous one and so the climax forests are composed of the most shade tolerant species (MacArthur and Connell 1966). However theoretically plausible, Connell and Slatyer (1977) found no convincing evidence for this mechanism. They favoured the third mechanism of species succession, the inhibition model, where early successional species inhibit the arrival of later species. Later species can only become established after individuals of the earlier species die or are damaged. The predictable patterns seen over time in secondary forest succession occur because early successional species are shorter-lived and are thus replaced more often than the longer-lived late successional species (Connell and Slatyer 1977). Tolerance of particular species also plays a role in this model since those species which can survive long periods of suppression by earlier species will more likely replace them when they die.

Connell and Slatyer's approach recognizes the role of communities as a whole in the successional process, but they also recognize the importance of the life history characteristics of individual species. They have thus formulated a synthesis of the organismic and individualistic theories of succession that disposes of the determinism of the organismic view while mediating the reductionism of the individualistic approach. With the advent of increased computing power new models of succession have been developed which follow this approach in attempting to combine the characteristics of individuals with overall stand dynamics (Shugart 1984).

The concept of the climax community remains very controversial. Many have abandoned the term as less deterministic and directional models of succession were formulated (Drury and Nisbet 1973), however the term is still widely used. Connell and Slatyer (1977) were not able to find any examples of sexually reproducing late-successional communities achieving a self-sustaining, steady-state equilibrium and thus concluded that generally succession never stops. The term "climax community", when still used, now refers to a mosaic of populations that interact with each other and the environment, and which also corresponds to, and changes with, the whole range of environmental conditions (Smith 1980, Shugart 1984). Thus the structure of a climax community, as the term is used in this thesis, is determined by the total environment and is dynamic instead of static.

1.2 PERMANENT PLOTS

A major difficulty in studying forest succession is the temporal dimension involved. The time periods elapsed during forest succession on one site are normally too long to be properly investigated in a single study. The time scales of research programmes are usually described in years while the time scales involved in forest succession span decades and even centuries. For these reasons many studies of forest succession involve the selection of different forest stands of different ages in order to reconstruct the successional sequence that would occur at a single site (Mueller-Dombois and Ellenberg 1974). The problem with this approach is that it is often very difficult to either (1) find different-aged sites that are physiographically identical and have identical disturbance histories, or (2) factor out all site-specific variables in determining the often complex patterns of forest community succession.

The establishment of permanently marked study plots has been advocated as one solution to mitigating many of these problems (Clements 1916; Watt 1957 & 1961; Grubb et al. 1982). If the plots are not disturbed, they can be periodically investigated by different researchers over time, and a more accurate picture of forest succession in that area can be gained. Ideally, a permanent plot should be large enough to encompass the full range of natural variation exhibited by the community type in which it is placed (i.e., the "minimal area" of that community type (Mueller-Dombois & Ellenberg 1974)). Too often the permanent plot has been much smaller than the minimal area and, therefore, monitoring changes within it tends to produce a distorted impression of the long-term stability of the community type. For example a forest community may be "globally stable" but "locally unstable". Plots that are too small will simply chronicle the "patch dynamics" of the forest mosaic (Shugart 1984) but not the dynamics of the forest as a whole. Clearly, it is preferable to describe both global and local dynamic changes.

In 1967, Roger Hnatiuk, after completing an extensive survey of *Pinus contorta* dominated forests in Jasper and Banff National Parks (Hnatiuk 1969, La Roi and Hnatiuk 1980), established and inventoried 5 permanently marked study plots. Although the sites were all dominated by pine in the tree canopy, they differed in moisture regime, elevation, and the other tree and understorey species present and were deliberately chosen to represent 5 widespread community types in the two parks. The National Parks provide an ideal location for the establishment of permanent study sites because of their long-term integrity and commitment to protection from humankind's more intensive uses of the wilderness.

1.3 OBJECTIVES

This study involved the re-establishment and second inventory in 1989 of 4 of Hnatiuk's intensive study plots. The data collected in 1989 were compared with the 1967 data in order to meet the following objectives. The objectives were:

1. To examine changes in the structure of the four *Pinus contorta* communities after a 22 year interval.
2. To test the hypothesis that the temporal stability of mountain pine forest ecosystems, measured in changes in tree species composition, tree-size class distributions, spatial distribution patterns, and understorey species cover, varies significantly with soil moisture and other site-specific conditions.
3. To evaluate the ability of permanent plots, configured in 400 quadrat, 1 hectare modules, to document both stand (site) and patch (quadrat) dynamic changes.
4. To assess the usefulness of permanent reference stands as ecological monitoring stations for detecting and documenting temporal changes in the tree population and physical environmental components of mountain forest ecosystems in Banff and Jasper National Parks.

1.4 STUDY AREAS

The study areas were located within *Pinus contorta* var. *latifolia* dominated forests in the Montane and Subalpine Ecoregions (Holland and Coen 1982) of the Canadian Rocky Mountains in Jasper and Banff National Parks.

Hnatiuk (1969), in his extensive survey of the vegetation in pine dominated forests that preceded the establishment of the permanent plots, divided *Pinus contorta* forests on the basis of moisture regime into three classes: Moist, Mesic, and Xeric. He further classified the pine forests on the basis of understorey vegetation type. The four permanent plots established in 1967, which provide the basis of this study, represent all three of these moisture classes. Table 1-1 shows the classification and location of each site.

Table 1-1. Classifications and locations of the four permanent plots in *Pinus contorta* forests of Jasper and Banff National Parks.

SITE	ATHABASCA	SUNWAPTA	WHIRLPOOL	HECTOR
CLASS[*]	xeric	mesic	moist	moist
VEGETATION TYPE[t]	*Arctostaphylos uva-ursi*	*Shepherdia canadensis*	*Hylocomium splendens*	*Menziesia ferruginea*
ECOREGION[**]	Montane	Lower Subalpine	Montane	Upper Subalpine
ECOSITE [**]	AT1	BV1	AT1	PP3
LANDFORM, GENETIC MATERIAL [**]	glacio-fluvial	glacio-fluvial	glacio-fluvial	fluvial
STAND AGE (1989)	83 y	96 y	151 y	103 y
ELEVATION	1100 m	1300 m	1130 m	1860 m
LATITUDE (N)	52° 57'	52° 34'	52° 43'	51° 31'
LONGITUDE (W)	117° 58'	117° 43'	117° 56'	116° 15'

[*] soil moisture, following Hnatiuk (1969)
[t] Hnatiuk 1969
[**] Holland and Coen (1982)
AT1 = ATHABASCA 1 Ecosite
BV1 = BOW VALLEY 1 Ecosite
PP3 = PIPESTONE 3 Ecosite

One of the sites, Hector, is located in Banff National Park (Figure 1-1A) and the other three sites, Athabasca, Sunwapta, and Whirlpool, are located in Jasper National Park (Figure 1-1B).

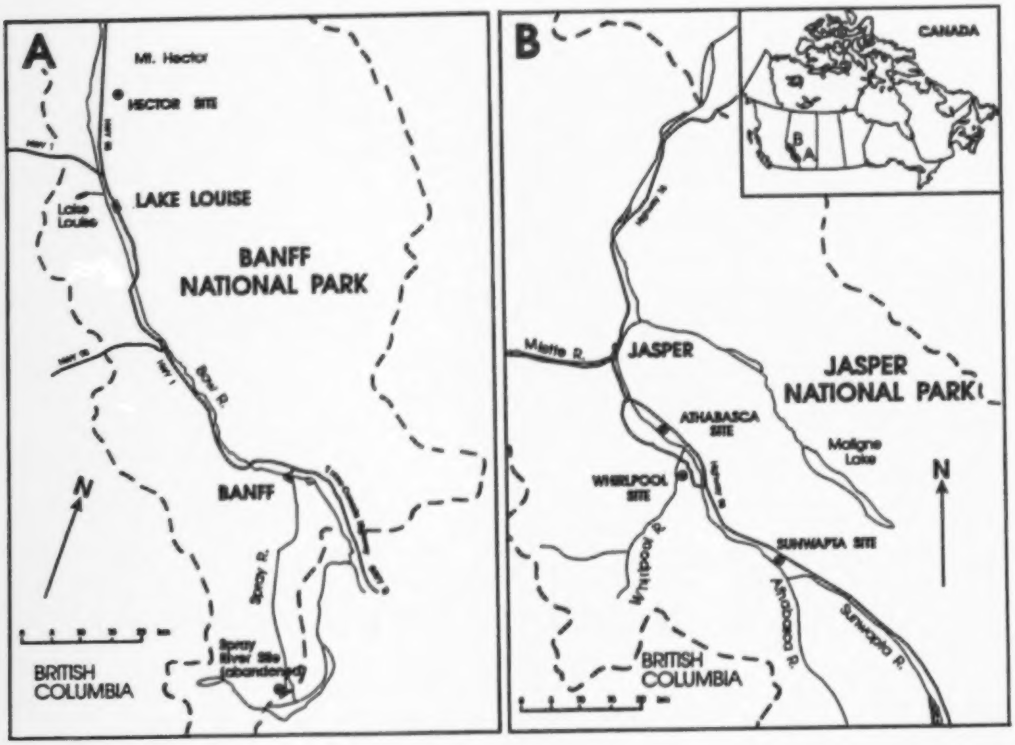

A
Mt. Hector
HECTOR SITE
LAKE LOUISE
Lake Louise
BANFF NATIONAL PARK
Bow R.
BANFF
Spray R.
Spray River Site (abandoned)
N
BRITISH COLUMBIA
B
CANADA
B
A
Miette R.
JASPER
JASPER NATIONAL PARK
ATHABASCA SITE
Maligne Lake
WHIRLPOOL SITE
Whirlpool R.
SUNWAPTA SITE
Athabasca R.
Sunwapta R.
N
BRITISH COLUMBIA

Figure 1-1. Maps of Banff and Jasper National Parks showing the locations of the four permanent study sites established by Hnatiuk in 1967.

1.4.1 Athabasca Site

The Athabasca site is located between Highway 93 and the Athabasca River about 15 km south of the Jasper town-site and is a representative of Hnatiuk's "xeric" moisture class (1969). The stand is situated in the middle of the broad Athabasca River valley at an elevation of 1100 m (the lowest of the four sites) on the upper of two large alluvial terraces bounded by the Athabasca River and low rocky ridges. The south-west corner of the stand drops down on to the lower terrace (Figure 1-2) and is within 150 m of the river itself. A "dune" of sandy soil runs through the north-central part of the stand (Figure 1-2). Hnatiuk (1969) postulated that this and other dunes in the area were old river islands and not wind deposits. The remainder of the stand was more level and the soils more coarse and stony.

In the surrounding area *Pinus contorta* is the dominant tree species on the drier river terraces although *Picea glauca* is abundant on the lower river terrace. *Pseudotsuga menziesii* is the dominant tree species on the low rocky ridges north-east of the stand. The understorey in the area is generally poorly developed and is dominated by *Arctostaphylos uva-ursi* and *Juniperus communis* (Table 1-1).

1.4.2 Sunwapta Site

The Sunwapta site, representing Hnatiuk's "mesic" soil moisture class, is located in the upper part of the Athabasca River valley just west of Highway 93, 1.6 km north of the turn-off to the Honeymoon Lake campground. It is situated at an elevation of 1300 m on the uppermost terrace of the Athabasca River just downstream of where the Sunwapta River flows into the Athabasca River. There are no major topographic discontinuities in the stand; however, Hnatiuk (1969) noted that the western half is flat with areas of exposed gravel, whereas the eastern half is hummocky (Figure 1-3). These hummocks vary in size with the largest being about 50 cm high and 2 m long.

The forest surrounding the stand is almost completely dominated by *Pinus contorta*. *Picea mariana* is found surrounding lakes which are 2-4 km to the east while occasional *Picea glauca/engelmannii* and *Abies lasiocarpa* trees can be found scattered throughout the lower valley forests in the stand vicinity. The understorey of the stand is

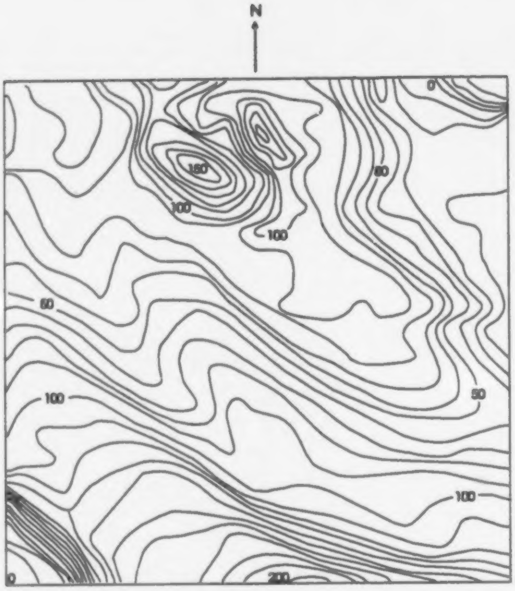

N
0
160
80
100
100
60
100
50
100
200
0

Figure 1-2. Topographical map of Athabasca permanent plot. The contour lines are 10 cm apart and the units shown are centimetres. (Modified from Hnatiuk 1969)

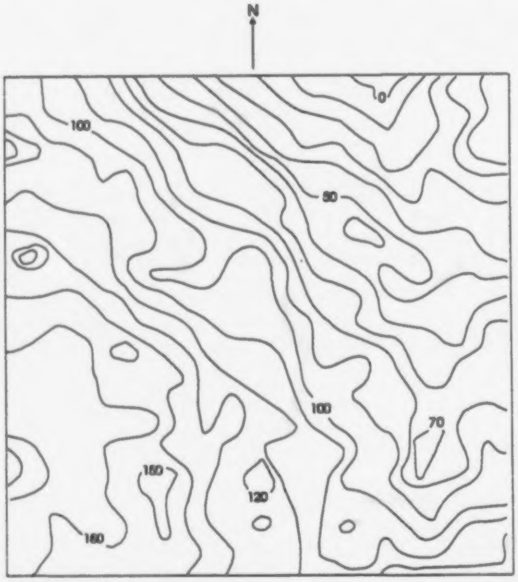

N
0
100
50
100
70
150
120
160

Figure 1-3. Topographical map of the Sunwapta permanent plot. The contour lines are 10 cm apart and the units shown are centimetres. (Modified from Hnatiuk 1969)

characterized by a well defined shrub stratum dominated by *Shepherdia canadensis* (Table 1-1).

1.4.3 Whirlpool Site

The Whirlpool site is located near the Whirlpool River just off Highway 93A (the old highway) 20 km south of Jasper and is a representative of Hnatiuk's "moist" soil moisture class. The stand is situated at an elevation of 1130 m on two terraces on the east side of the Whirlpool River about 1.6 km from its confluence with the Athabasca River. The lower terrace is essentially flat while the upper terrace is slightly undulating and between 1 and 2 m above the lower one (Figure 1-4). The ridge forming the discontinuity between the two terraces runs parallel to the river and diagonally through the site, from the northwest to the southeast, and forms the major topographic feature in the site. A depression in the upper terrace is present in the northern portion of the stand (Figure 1-4). The lower terrace is only about 1 m above the normal summer water level of the Whirlpool River.

Pinus contorta is the dominant tree species in the area surrounding the stand although *Picea mariana*, *Abies lasiocarpa*, and *Picea glauca/engelmannii* are quite common near the river. Hnatiuk (1969) noted that several small marl lakes to the south were surrounded by *Picea mariana*. The understorey of the forest in and surrounding the stand is dominated by feather mosses (*Hylocomium splendens*, *Pleurozium schreberi*, and *Ptilium crista-castrensis*) (Table 1-1).

1.4.4 Hector Site

The Hector site is located in the upper Bow River valley of northern Banff National Park (see Figure 1-1A) above Highway 93, 8.6 km north of its junction with the Trans Canada Highway. Like Whirlpool, it is a representative of Hnatiuk's "moist" soil class. It is situated at an elevation of 1860 m on the southwest slope of Mount Hector and is the highest of the four sites. The stand is located on a steep slope (about 25 degrees) in contrast to the relatively level topography of the other three stands. The slope of the stand is topographically quite uniform with the exception of the southeast corner which dips into a steep-sided ravine (Figure 1-5).

This stand is situated in the upper subalpine *Picea/Abies* Ecoregion (Table 1-1) where the forest composition is mixed *Picea engelmannii*, *Abies lasiocarpa*, and *Pinus contorta*, the latter increasing in relative abundance with decreasing elevation. A prominent fire margin through the northwest corner of the stand and the presence of large fire-killed snags throughout the stand provide strong evidence that fire produced the conditions allowing *Pinus contorta* to dominate this stand despite its higher altitude. The understorey of the forests in the area is strongly dominated by *Menziesia ferruginea* (false azalea) (Table 1-1).

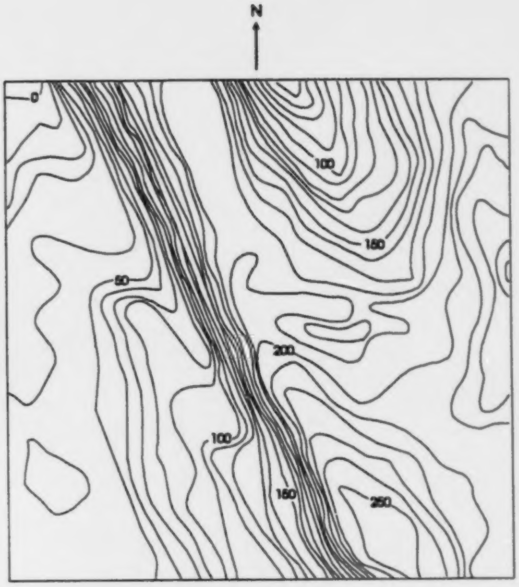

N
0
100
150
50
200
100
150
250

Figure 1-4. Topographical map of the Whirpool permanent plot. The contour lines are 10 cm apart and the units shown are centimetres. (Modified from Hnatiuk 1969)

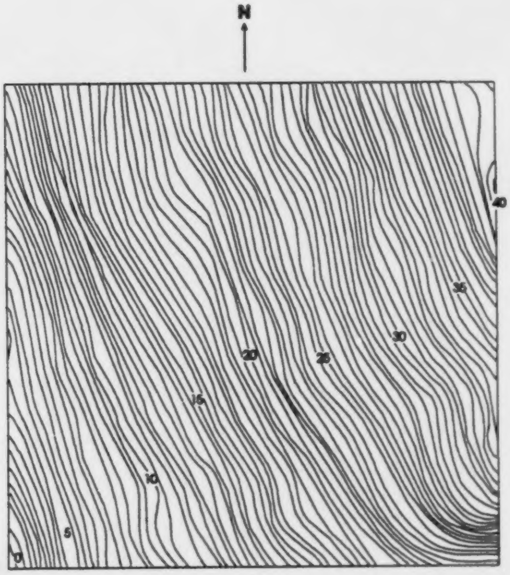

N
40
35
30
25
20
15
10
5
0

Figure 1-5. Topographical map of the Hector permanent plot. The contour lines are 50 cm apart and the units shown are metres. (Modified from Hnatiuk 1969)

1.4 GEOLOGY AND SOILS

Banff and Jasper National Parks fall within what are commonly called the central Canadian Rocky Mountains. All four of the permanent plots fall within the "eastern main ranges" of the Rocky Mountains which are east of the continental divide. The "eastern main ranges" are underlain by Precambrian and Early Palaeozoic rock and have been carved from a single, tough thrust sheet that began to move at about 110-120 million years ago (Gadd 1986). The rock is mainly quartzite and limestone in the eastern main ranges in contrast to the slate rock found west of the continental divide (Gadd 1986).

The geological parent materials of the soils at the four permanent plots were mostly derived from Precambrian and Lower Cambrian quartzites and sandstones and Upper and Lower Palaeozoic limestones and dolomites. This parent material occurs primarily as glacial drift and alluvial deposits overlying the bedrock in the valley bottoms (Athabasca, Whirlpool, and Sunwapta sites) whereas on the valley walls it is in the form of colluvium and weathered bedrock in addition to glacial till (Hector site) (Hnatiuk 1969). In the ecological and biophysical land classification carried out in the 1970's, the textures of the mineral genetic materials at the locations of the Athabasca, Sunwapta, and Whirlpool permanent plots were classified as "coarse", while at Hector it was classified as "stratified" (Holland and Coen 1982).

The soils at Athabasca, Whirlpool, and Hector sites were classified as "Degraded Eutric Brunisols" by Hnatiuk (1969). This classification corresponds to the "Eluviated Eutric Brunisol" in the Canadian System of Soil Classification - Second Edition (1987). These soils have a Bm horizon, which have insufficient eluvial clay to be called a Bt horizon (and thus be classified as Luvisols), and have a relatively high degree of base saturation as indicated by their pH and lack of a well-developed mineral-organic surface horizon (Canadian System of Soil Classification 1987).

Hnatiuk (1969) classified the soil at the Sunwapta site as an "Orthic Grey Luvisol" which has well developed Ae and Bt horizons and occurs in areas where the mean annual soil temperature is less than 8°C (Canadian System of Soil Classification 1987).

The pH of the B horizons at the four sites ranged from 6.0 at Hector and 6.6 at

Whirlpool to 7.0 and 7.1 at Athabasca and Sunwapta (Hnatiuk 1969). Hnatiuk (1969) determined that these high pH values were due to the widespread occurrence of carbonates in the two National Parks. The lower pH values at the two moist sites is likely due to the leaching of carbonates as a result of higher precipitation. In addition to the leaching of carbonates, the lower pH at Hector may also be due to cooler temperatures at this higher elevation site favouring the accumulation of organic acids as the major products of decomposition (Hnatiuk 1969).

1.5 CLIMATE

The climate along the Icefields Parkway in the Canadian Rocky Mountains is transitional between maritime-dominated to the west and continental-dominated to the east. Thus the winter temperatures of Banff and Jasper are somewhat higher than elsewhere in west-central Alberta (Tande 1977). The climate diagrams for Jasper townsite and Sunwapta ranger station (Figures 1-6 and 1-7) show the continental influence in that most of the yearly precipitation falls in the summer. In climates where maritime Pacific systems are the dominant influence most of the precipitation falls in the winter. This influence is quite strong at Lake Louise (Figure 1-8) where Pacific systems are more able to penetrate the Rocky Mountain barrier than at Jasper and Sunwapta. Hence, precipitation at Lake Louise is about 50% higher than at the other 2 stations. The transitional nature of the climate at all 3 stations can be seen in their summer and winter precipitation peaks.

Temperatures at the 3 stations are largely determined by elevation. Jasper, which is the lowest of the stations, is also the warmest and has the most months with mean daily temperatures >0° C. However, all three stations can have minimum temperatures below 0° C throughout the summer (Figures 1-6 to 1-8).

The climate at the Athabasca site is probably accurately reflected by the Jasper townsite station (Figure 1-6) which is only 13 km away, although Hnatiuk found Athabasca to be slightly drier than Jasper during his study in 1968 (Hnatiuk 1969). However, the Whirlpool site, only 2 km from the Athabasca site, has a much wetter climate than Athabasca which is likely a result of Pacific systems moving across Athabasca pass and down the Whirlpool valley. During the summers of 1989 and 1990 it appeared that the Athabasca site was shielded from these systems by a rainshadow created by Mt. Edith Cavell.

The Sunwapta site is 200 m below and 15 km north of the Sunwapta warden station and will therefore be slightly warmer than the climate shown in Figure 1-7.

The Hector site is up the Bow River valley from the Lake Louise station and is 300 m higher in elevation. Winter snowfalls increase with elevation and temperature falls about half a degree Celsius for every 100 m elevation gain, so the Hector stand is likely slightly colder and wetter than Lake Louise (Gadd 1986).

1.5.1 Climatic Variation 1966-1989

The average May-August precipitation and temperature between 1966 and 1989 at Jasper and Lake Louise are recorded in Figures 1-9 and 1-10 because the climate during these months most strongly influences the over- and understorey vegetation growth and cover. The pattern of variation in temperature and precipitation from 1966 to 1989 was very similar between the Jasper and Lake Louise stations. 1970 and 1971 had very warm summers while the summers between 1974 and 1977 were cool. The years 1967 and 1989, when the two study inventories were done, are of particular interest. The average May-August temperature was slightly lower in 1989 than in 1967 at both stations. However, a significant difference was seen in the precipitation that fell in the two summers. 1967 had the driest growing season in the 1966-1989 interval at Lake Louise, and Jasper also had below average precipitation that summer. In contrast, 1989 was the wettest growing season at Jasper and among the wettest at Lake Louise between 1966 and 1989. At Jasper five of the six years before 1989 and four of the six years before 1967 had below average precipitation (Figure 1-9). The same precipitation trend occurred at Lake Louise before 1989; however a series of wetter summers occurred in the six years before 1967 when four summers had above average precipitation (Figure 1-10).

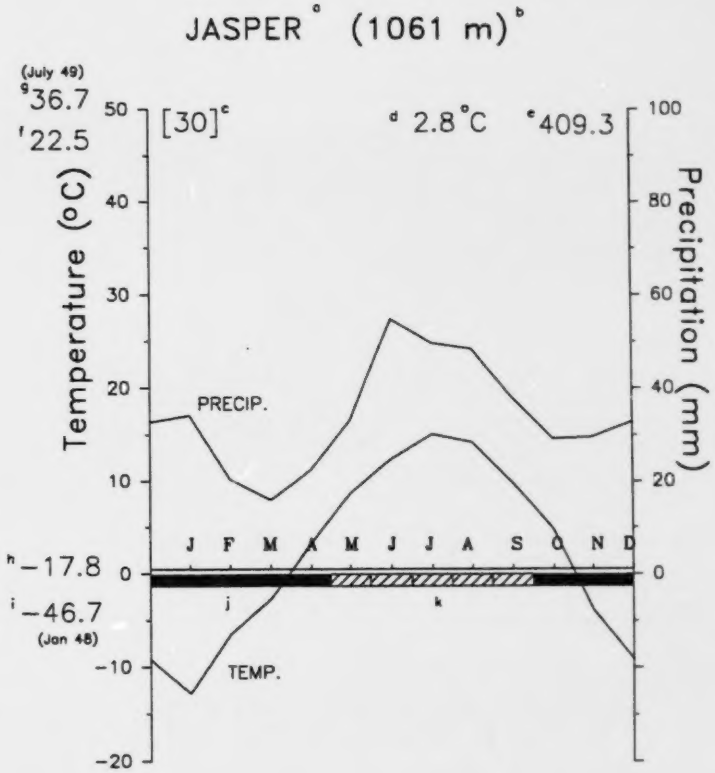


Figure 1-6. Climate diagram (Walter 1984) for Jasper townsite in Jasper National Park, Alberta. a=location, b=elevation, c=years of observation, d=mean annual temperature (°C), e=mean annual precipitation (mm), f=mean daily temp. max. of warmest month, g=absolute maximum temperature, h=mean daily temp. min. of coldest month, i=absolute minimum temperature, j=months with mean daily minimum <0°C, k=months with absolute minimum <0°C.

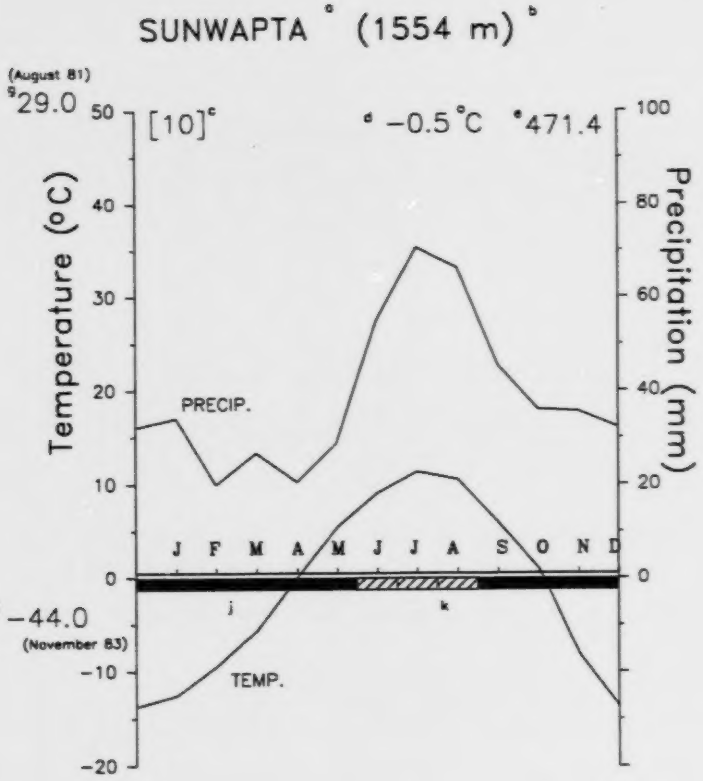


Figure 1-7. Climate diagram for the Sunwapta ranger station in Jasper National Park, Alberta. a=location, b=elevation, c=years of observation, d=mean annual temperature (°C), e=mean annual precipitation (mm), f=mean daily temp. max. of warmest month (missing), g=absolute maximum temperature, h=mean daily temp (missing). min. of coldest month, i=absolute minimum temperature, j=months with mean daily minimum <0°C, k=months with absolute minimum <0°C.

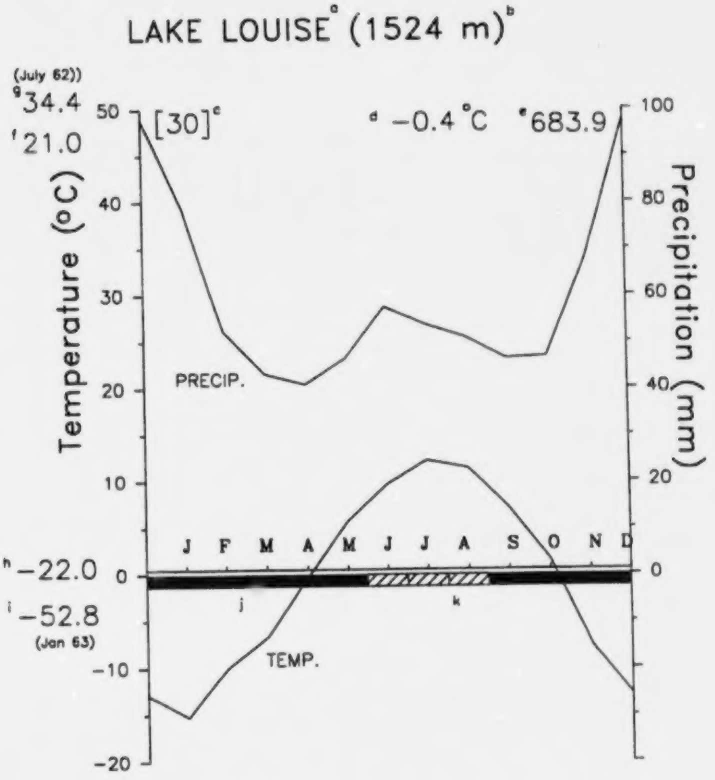
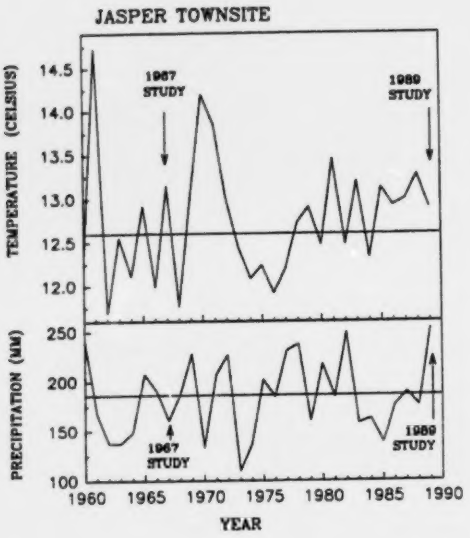
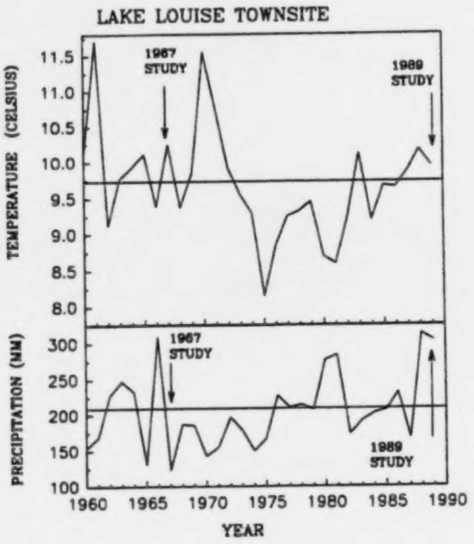


Figure 1-8. Climate diagram for Lake Louise townsite in Banff National Park, Alberta. a=location, b=elevation, c=years of observation, d=mean annual temperature (°C), e=mean annual precipitation (mm), f=mean daily temp. max. of warmest month, g=absolute maximum temperature, h=mean daily temp. min. of coldest month, i=absolute minimum temperature, j=months with mean daily minimum <0°C, k=months with absolute minimum <0°C.





Figures 1-9 and 1-10. May to August precipitation and average temperature at the Jasper townsite (Figure 1-9) and Lake Louise (Figure 1-10) climate stations between 1960 and 1989. The dashed lines indicate precipitation and temperature normals based on 30 years of records of May to August conditions.

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CHAPTER 2. TREE SPECIES DYNAMICS

2.1 INTRODUCTION

Pinus contorta var. *latifolia* Engelm. is a widespread, needle-leaf, evergreen tree species of western North America ranging from the central Yukon to northern Baja California and from just above sea level to over 3300 m in the southern Sierra Nevada (Critchfield and Little 1966). In the forests of the Canadian Rocky Mountains it is the most important seral tree species (La Roi and Hnatiuk 1980). *Pinus contorta* stands are most widespread in the Montane and Subalpine Ecoregions where fire, which is crucial in maintaining the dominance of *Pinus contorta*, plays an important ecological role (Hnatiuk 1969; La Roi *et al.* 1975). In the absence of stand-destroying fires, *Pinus contorta* is seral to *Pseudotsuga menziesii* in drier Montane habitats while in wetter Subalpine environments it is seral to *Picea engelmannii* and *Abies lasiocarpa* (Beil 1966). In wet Montane environments *Pinus contorta* is often seral to *Picea mariana* (Laidlaw 1971). However, in the Montane and lower Subalpine Ecoregions these successional sequences are rarely completed, being interrupted by fire. In certain situations, in the absence of fire and where recruitment of *Picea* and *Abies* is low and *P. contorta* recruitment is sufficient to replace mortality, *P. contorta* climax communities can occur (La Roi and Hnatiuk 1980; Despain 1983; Parker 1986; Stuart *et al.* 1989).

This chapter focuses on tree population dynamics in four of the permanent reference stands that were established by R. Hnatiuk in 1967 (see Chapter 1) and will attempt to relate differences in the tree dynamics seen at these sites to their moisture regimes and other site-specific factors.

2.2 METHODS

2.2.1 Field Methods

The study objectives required the re-establishment of four of R. Hnatiuk's five one-hectare plots and the gridding of each plot into 400 5 × 5 m contiguous quadrats. Hnatiuk's plot on the Spray River in southern Banff National Park had to be left out of the study due to its relative inaccessibility following closure of the Spray River fire road. The sites were relocated using Hnatiuk's thesis (1969) and a metal detector to find the railway spikes he had used to mark the sites in 1967. The four re-established 20 x 20 grids of 5 × 5 m quadrats corresponded precisely to those Hnatiuk had established in 1967.

The following procedures were carried out for all 400 5 × 5 m quadrats at each of the four sites.

(1) Living trees in each quadrat were identified to species and directly placed in 3 inch (7.5 cm) diameter at breast height (DBH) classes. The number of "seedlings" (<30 cm tall) and "transgressives" (≥30 cm tall but <2.5 cm DBH)(Hnatiuk 1969) were also recorded for each quadrat. DBH classes were measured in inches because all the 1967 measurements were recorded in 3 inch DBH classes. Swedish tree calipers were used to measure diameter. The number of standing dead trees in each quadrat was also recorded.

(2) Ocular estimates were made of total tree canopy cover to the nearest 1% over each quadrat, however these results are not presented as the estimates proved unreliable.

(3) A Lemmon Model A Spherical Densiometer was used to estimate the percent exposure of the quadrat corners to the sky. The 1967 densiometer data are missing making impossible comparisons between the years.

The grid at each site was subdivided into 25 20 x 20 m blocks each containing 16 quadrats. A single quadrat was chosen from each block. Hnatiuk had randomly selected a quadrat from each block in 1967 and the same quadrats were selected for the 1989 study.

The following procedures were carried out in each of these 25 quadrats per site.

(1) A basal area reading of trees by species was taken using a Bitterlich 10X prism at the centre of the quadrat.

(2) In 1967 the height of a randomly selected tree was determined using a clinometer, tape measures, and trigonometric calculations. In 1989 the heights of every tree in the same quadrats were recorded using the same method. It was not possible to relocate the randomly selected trees measured in 1967 and therefore height comparisons between 1967 and cannot be made with any degree of confidence.

2.2.2 Laboratory

The 1967 and 1989 data were entered onto Lotus 123 V.3 computer files.

Coefficients of dispersion (variance : mean ratios of density distribution, Blackman 1942) were calculated to describe the spatial dispersion patterns of trees, transgressives, and seedlings throughout the 400 quadrats of each site. The coefficient of dispersion makes use of the equality of mean and variance of the Poisson distribution and thus if the ratio of variance to mean is less than one, a regular distribution is indicated, and if greater than one, a contagious distribution is indicated (Greig-Smith 1983). A t-test was used to test the significance of the difference between the observed ratio and unity using the following formula to calculate standard error (Greig-Smith 1983):

$$S=\sqrt{\frac{2}{N-1}}$$

Paired sample t-tests were carried out to test for significance of differences between basal area estimates from the two study years. Paired-sample tests could be used as the Bitterlich basal area readings were made from the same 25 locations in each of the study years. These basal area estimates were compared with estimates calculated using the DBH classes all trees above 2.5 cm were assigned to. As trees were placed directly in DBH classes, the midpoint diameter of each DBH class was used to calculate the basal area of each tree.

Tree species nomenclature follows Moss (1983).

2.3 RESULTS

2.3.1 Total Tree Density and Cover

Over the 22 year period between 1967 and 1989 total tree stem density declined greatly at the Athabasca site (-44%), moderately at Sunwapta (-22%), and less at Whirlpool (-11%); but increased slightly at Hector (+4%) (Table 2-1). These differences in the magnitude of change in tree density at the four sites were correlated with their moisture regimes: the largest decline occurred at the xeric Athabasca site and the sole density increase occurred at the moist Hector site (note that in the tables the four sites are always listed in order from xeric to moist).

Canopy cover in 1989, as estimated using densiometer exposure measurements, followed the moisture gradient of sites being highest at the two moist sites, Hector (73% cover) and Whirlpool (70%), lower at mesic Sunwapta (61%), and lowest at xeric Athabasca (52%) (see Figure 2-12 for cover distributions).

2.3.2 Individual Tree Species Density

Pinus contorta was the only tree species in the canopies of the two drier sites (Athabasca and Sunwapta) in 1967; by 1989 this had changed very little. In the two moist sites (Whirlpool and Hector), however, *P. contorta* increasingly shared the total density with other species, though retaining dominance (Figures 2-1 and 2-2). At Whirlpool, *Picea mariana* and *Populus tremuloides* together accounted for > 20% of the tree stems in 1967; by 1989 the relative density of *P. mariana* had greatly increased to 46%, while that of *P. contorta* fell to 52% (Figure 2-1).

At Hector the change in relative density between 1967 and 1989 was not as dramatic as at Whirlpool, but a similar trend was evident (Figure 2-2). *P. contorta* fell from 93% to 79% while *Picea engelmannii* and *Abies lasiocarpa* both increased proportionately (Figure 2-2).

The absolute density of *P. contorta* declined at all four sites in the 22 year interval including Hector where, as was seen in Table 2-2, total tree density also increased (Table 2-1). The dramatic reduction in the proportion of *P. contorta* stems at Whirlpool (Figure

Table 2-1. Density and dispersion of trees and standing dead stems (stems taller than 30 cm with DBH's greater than 2.54 cm) in the four permanent plots in 1967 and 1989. Pico = *Pinus contorta*, Pigl = *Picea glauca*, Pien = *Picea engelmannii*, Pima = *Picea mariana*, Abla = *Abies lasiocarpa*, Potr = *Populus tremuloides*. Totals refer to living trees only.

STAND	YEAR	SPECIES	TREE STEMS	% CHANGE FROM 1967	VARIANCE / MEAN RATIO*
Athabasca	1967	Pico	2782		4.4508
		Total	**2782**		**4.4508**
		Dead	1213		6.2238
	1989	Pico	1559	- 44.0%	2.2447
		Pigl	12	+ ∞	-
		Pima	1	+ ∞	-
		Total	**1572**	**- 43.5%**	**2.2231**
		Dead	705	- 42.9%	2.1634
Sunwapta	1967	Pico	740		2.0416
		Total	**740**		**2.0416**
		Dead	36		–
	1989	Pico	578	- 21.9%	1.2799
		Pigl	2	+ ∞	-
		Abla	1	+ ∞	-
		Total	**581**	**- 21.5%**	**1.2891**
		Dead	71	+ 97.2%	–
Whirlpool	1967	Pico	1082		0.8517
		Pigl	5		-
		Pima	262		-
		Potr	19		-
		Total	**1368**		**1.1721**
		Dead	488		1.4434
	1989	Pico	631	- 41.7%	0.7810
		Pigl	15	+200.0%	-
		Pima	546	+108.4%	-
		Potr	10	- 47.4%	-
		Total	**1216**	**- 11.1%**	**1.6268**
		Dead	373	- 23.2%	1.3619
Hector	1967	Pico	3187		2.5909
		Pien	196		-
		Abla	50		-
		Total	**3433**		**2.3623**
		Dead	151		1.6996
	1989	Pico	2835	- 11.0%	2.0177
		Pien	535	+173.0%	-
		Abla	199	+298.0%	-
		Total	**3569**	**+ 3.9%**	**1.6277**
		Dead	485	+221.2%	1.8747

* variance : mean ratio of density in 5 × 5 m quadrats (see Methods)

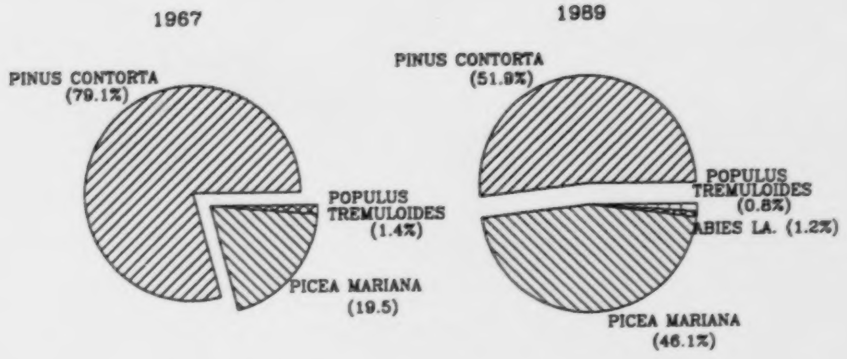


Figure 2-1. Pie graphs showing the species make-up of the canopy at the Whirlpool site in terms of percentage of tree stems.

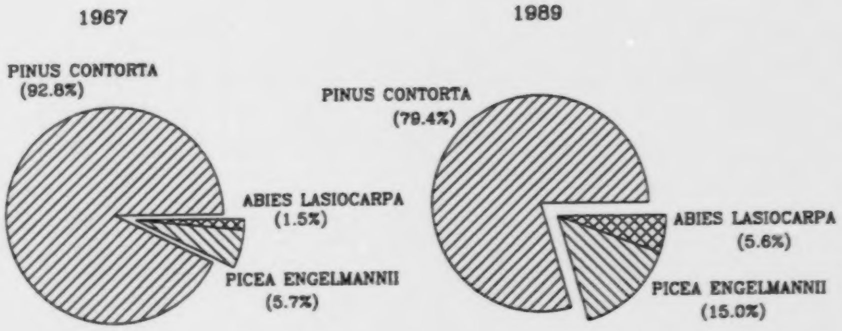


Figure 2-2. Pie graphs showing the species make-up of the canopy at the Hector site in terms of percentage of tree stems.

Table 2-2. Variance : Mean ratios of individual size classes of tree species in the four study sites for both study years. Pico = *Pinus contorta*, Pima = *Picea mariana*, Pien = *Picea engelmannii*, Abla = *Abies lasiocarpa*. All ratios were significantly different from unity (p<0.05)). The dash (-) indicates species size classes with too few individuals to calculate a meaningful ratio.

SIZE CLASS		ATHABASCA	SUNWAPTA	WHIRLPOOL		HECTOR		
		Pico	Pico	Pico	Pima	Pico	Pien	Abla
SEEDLING	1967	2.98	7.05	2.86	16.52	-	1.81	1.83
	1989	2.22	2.96	1.36	2.35	-	1.62	2.03
TRANSGR.	1967	2.76	6.47	7.20	15.02	-	4.92	4.19
	1989	1.95	7.04	4.69	7.84	-	3.29	3.15
2.5cm-	1967	5.20	3.00	-	1.33	2.07	1.81	1.83
7.6cm	1989	2.39	1.62	-	2.88	2.05	2.05	2.69
7.7cm-	1967	1.69	1.38	1.12	1.18	1.76	-	-
15.2cm	1989	1.94	1.37	0.99	1.45	2.26	-	-
15.3cm-	1967	1.25	1.18	0.92	1.61	1.20	-	-
22.9cm	1989	1.02	1.26	0.98	1.13	0.89	-	-
23.0cm-	1967	1.10	1.07	1.05	-	-	-	-
30.5cm	1989	1.04	0.92	0.92	-	-	-	-

Table 2-3. Basal area estimates (m^2 ha^{-1}) for tree species and standing dead at the four study sites in 1967 and 1989 calculated using 25 Bitterlich prism measurements per site (BITT) and calculated from DBH size classes (DBH). S.D. is the sample standard deviation of the mean of the Bitterlich prism estimates.

SPECIES		**ATHABASCA**		**SUNWAPTA**		**WHIRLPOOL**		**HECTOR**	
		1967	**1989**	**1967**	**1989**	**1967**	**1989**	**1967**	**1989**
Pinus contorta	BITT	17.9	13.8^{b}	16.6	19.6^{a}	25.7	20.5^{b}	35.3	37.8^{N}
	S.D.	(7.6)	(5.9)	(5.0)	(5.3)	(5.1)	(6.0)	(10.0)	(13.6)
	DBH	*18.2*	*18.1*	*15.7*	*21.5*	*29.8*	*24.1*	*32.9*	*42.9*
Picea spp.*	BITT	0	0.1	0	0	2.6	3.0^{N}	1.6	1.9^{N}
	S.D.		(0.5)			(2.8)	(3.2)	(4.0)	(3.0)
	DBH	*0*	*0.1*	*0*	*0.004*	*2.5*	*4.7*	*0.7*	*2.0*
Abies lasiocarpa	BITT	0	0	0	0	0	0.1	0.3	0.4
	S.D.						(0.5)	(1.0)	(1.5)
	DBH	*0*	*0*	*0*	*0.002*	*0*	*0.044*	*0.2*	*0.7*
Populus tremuloides	BITT	0	0	0	0	0.2	0.5^{N}	0	0
	S.D.					(0.9)	(1.3)		
	DBH	*0*	*0*	*0*	*0*	*0.4*	*0.5*	*0*	*0*
Dead	BITT	1.8	4.3^{N}	0	0	6.3	6.6^{N}	2.0	2.9^{N}
	S.D.	(4.3)	(5.7)			(3.9)	(4.6)	(2.2)	(3.4)
Total Living	BITT	17.9	13.9^{b}	16.6	19.6^{a}	28.4	24.1^{b}	37.3	40.1^{N}
	S.D.	(7.6)	(5.9)	(5.0)	(5.3)	(5.4)	(6.8)	(9.1)	(11.7)
	DBH	*18.16*	*18.23*	*15.67*	*21.50*	*32.67*	*29.31*	*33.86*	*45.56*

[*] *Picea glauca* at Athabasca, *P. mariana* at Whirlpool, and *P. engelmannii* at Hector.
[N] 1989 estimate not significantly different from 1967 estimate (p>0.05).
[a] 1989 estimate significantly different from 1967 estimate (p<0.05).
[b] 1989 estimate significantly different from 1967 estimate (p<0.01).

2-1) was the result of an increase in *P. mariana* density combined with a decline in *P. contorta* density between 1967 and 1989. *P. contorta* mortality was highest at the xeric Athabasca and moist Whirlpool stands (Table 2-1). At Athabasca there was little increase in the density of other tree species, but at Whirlpool *P. mariana* density increased greatly (Table 2-1 and Figure 2-1).

2.3.3 Tree Dispersion

The variance : mean ratio of density (see Methods) for total trees (and *P. contorta*) at Athabasca was 4.45 in 1967, indicating a high degree of clumping (Table 2-1). By 1989, the variance : mean ratio had dropped to 2.22, indicating that the areas of highest tree density had suffered the greatest mortality. The net change in dispersion from clumped towards uniform took place largely in the 2.5 - 7.5 cm DBH class (Table 2-2). The variance : mean ratios fell to a lesser extent at Sunwapta and Hector.

In contrast, the variance : mean ratios for total trees at Whirlpool were much less clumped, and increased from 1.17 in 1967 to 1.63 in 1989 (Table 2-1). The ratio for *P. contorta* decreased slightly over the interval while that for the asexually layering *P. mariana* increased (Table 2-1).

2.3.4 Tree Basal Area

The basal area estimates of tree species other than *P. contorta* was zero or low (Table 2-3). Only *Picea* spp. achieved basal area values > 1 m^2 ha^{-1} and these meagre totals were only achieved at the Whirlpool and Hector sites. The basal area of *P. contorta* was highest at the moist Hector site and lowest at the two xeric sites, Athabasca and Sunwapta, in 1967. However, unlike tree density, basal area changes over the 1967-1989 interval did not follow the moisture regime ordering of the four sites. Significant decreases in *P. contorta* basal area occurred at the two montane sites, xeric Athabasca and moist Whirlpool, while a significant increase in *P. contorta* basal area occurred at the mesic subalpine Sunwapta site. *P. contorta* basal area did not change significantly at Hector. Although the densities of *Picea* spp. and *Abies lasiocarpa* did increase substantially at Whirlpool and Hector (Table 2-1), no significant increases in basal area were seen at these sites (Table 2-3). The significance of changes in total tree basal area followed the same pattern in the four sites as that for *P. contorta*.

The basal area of standing dead trees was highest at Whirlpool, which was also the oldest stand, and nil at Sunwapta. No significant changes in standing dead basal area were seen between 1967 and 1989 (Table 2-3).

The basal areas calculated from tree DBH size classes followed much the same pattern as those determined using the Bitterlich prism (see Methods), but were consistently higher than the Bitterlich estimates. At Athabasca the decline in *P. contorta* basal area was small according to the DBH based estimates, while the increase in pine basal area at Hector was greater than shown by the Bitterlich estimates (Table 2-3).

2.3.5 Tree Height

Mean heights of *Pinus contorta* trees were lowest at Athabasca (ca. 11 m) and highest at Whirlpool and Sunwapta (ca. 21 m; Table 2-4). Because the number of height measurements differed between sites, a general linear model ANOVA (SAS v6.06) was used to test the hypothesis that mean tree heights at the four sites were not significantly different. This hypothesis was rejected ($F=117$ $p<0.0001$). Tukey's studentized range test (a means separation test, SAS v 6.06) indicated that *P. contorta* heights were not significantly different between Sunwapta and Whirlpool, whereas all other combinations of sites were significantly differences.

2.3.6 Immature Tree Density

The total density of immature trees (i.e., seedlings and transgressives; see Methods) declined at Sunwapta, Whirlpool and Hector, but increased substantially at Athabasca between 1967 and 1989 (Table 2-5).

Immature *P. contorta* density was extremely high at the Sunwapta site on both sampling dates (although seedling density did decline somewhat), but was virtually nil at the Hector site (Table 2-5).

Immature *Picea* density was highest at Whirlpool and Hector, quite low at Athabasca, and almost zero at Sunwapta (Table 2-5); it declined about one-third between

Table 2-4. Tree heights (m) measured from all trees in 25 randomly selected quadrats at each site in 1989. S.D. is the sample standard deviation of the mean. MAX is the tallest tree measured. N is the number of trees measured.

SPECIES	ATHABASCA	SUNWAPTA	WHIRLPOOL	HECTOR
Pinus contorta				
Mean	10.8	21.3	20.9	13.8
S.D.	2.6	5.9	3.7	2.9
MAX	17.4	28.9	34.7	21.8
N	54	24	50	161
Picea spp.[*]				
Mean			14.4	11.4
S.D.			3.8	4.7
MAX			18.3	17.7
N			24	5

[*] *Picea mariana* at Whirlpool and *P. engelmannii* at Hector

Table 2-5. Density and dispersion of immature trees (stems with a DBH less than 2.54 cm or shorter than 30 cm) in the four permanent plots in 1967 and 1989. Pico = *Pinus contorta*, Pigl = *Picea glauca*, Pien = *Picea engelmannii*, Pima = *Picea mariana*, Abla = *Abies lasiocarpa*, Potr = *Populus tremuloides*.

STAND	YEAR	SPECIES	TREE STEMS	% CHANGE FROM 1967	VARIANCE MEAN RATIO*
Athabasca	1967	Pico	768		2.8710
		Pigl	41		-
		Abla	7		-
		Total	**816**		**2.8323**
	1989	Pico	962	+ 25.3%	2.6786
		Pigl	146	+256.1%	-
		Abla	62	+785.7%	-
		Potr	23	+ ∞	-
		Total	**1193**	**+ 46.2%**	**2.7200**
Sunwapta	1967	Pico	6130		10.05
		Pigl/en	9		-
		Abla	13		-
		Potr	50		-
		Total	**6202**		**9.9387**
	1989	Pico	5211	- 15.0%	7.6497
		Pigl/en	11	+ 22.2%	-
		Pima	1	+ ∞	-
		Abla	43	+230.8%	-
		Potr	6	- 88.0%	
		Total	**5272**	**- 15.0%**	**7.6863**
Whirlpool	1967	Pico	737		6.3974
		Pigl	7		-
		Pima	3009		15.857
		Abla	35		-
		Potr	53		-
		Total	**3841**		**12.078**
	1989	Pico	870	+ 18.0%	4.8187
		Pigl	10	+ 42.9%	-
		Pima	1925	- 36.0%	8.3518
		Abla	66	+ 88.6%	-
		Potr	74	+ 39.6%	-
		Total	**2945**	**- 25.1%**	**5.1469**
Hector	1967	Pico	49		-
		Pien	1931		5.1058
		Abla	636		4.1765
		Total	**2618**		**6.1562**
	1989	Pico	21	- 57.1%	-
		Pien	1287	- 33.4%	3.4352
		Abla	526	- 17.3%	3.3435
		Total	**1834**	**- 29.9%**	**4.3889**

* variance : mean ratio of density in 5 × 5 m quadrats (see Methods)

1967 and 1989 at Whirlpool and Hector but increased more than two-fold at Athabasca.

A significant density of immature *Abies lasiocarpa* (subalpine fir) occurred only at the Hector site, where it declined by one-sixth between 1967 and 1989 (Table 2-5). At Athabasca, immature *A. lasiocarpa* density, although still relatively low, increased greatly over the 22 year interval.

Despite the presence of *Pseudotsuga menziesii* trees on a ridges south and east of the Athabasca permanent plot, no *P. menziesii* seedlings were seen at Athabasca in 1967 or 1989.

2.3.7 Immature Tree Dispersion

The variance : mean ratio for total immature tree density was highest at Whirlpool and successively lower for Sunwapta, Hector, and Athabasca. It declined between 1967 and 1989 at all four sites.

The dispersion of immature *P. contorta* was highly clumped at Sunwapta, moderately clumped at Whirlpool, and least so at Athabasca (Table 2-5). The dispersion of immature *P. contorta* could not be determined at Hector because the density of stems was too low.

Immature *P. mariana* trees were highly clumped at Whirlpool, although the degree of clumping did decline along with density between 1967 and 1989 (Table 2-5). At Hector, immature *P. engelmannii* and *A. lasiocarpa*, had lower degrees of clumping which also declined over the interval (Table 2-5).

2.3.8 Tree Size Class Distribution

2.3.8.1 Athabasca

The size class distribution of trees at Athabasca (Figure 2-3) shows that the great decline in tree density (Table 2-1), in this almost exclusively pine stand, occurred in the smallest DBH class (2.5-7.6 cm). Trees in this size class comprised the majority of the individuals occurring in the high density areas described in 2.3.3 (Table 2-1).

Most of the other DBH classes increased in density, except for the largest class (30.5 - 38 cm) which declined from 20 individuals to just 8 (Figure 2-3). Only 3 of these

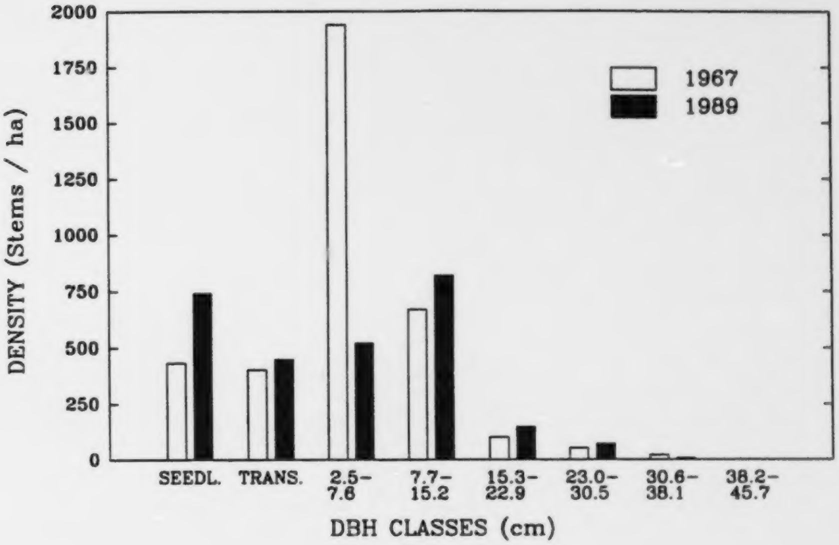


Figure 2-3. Size class distribution of all trees at Athabasca for 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.

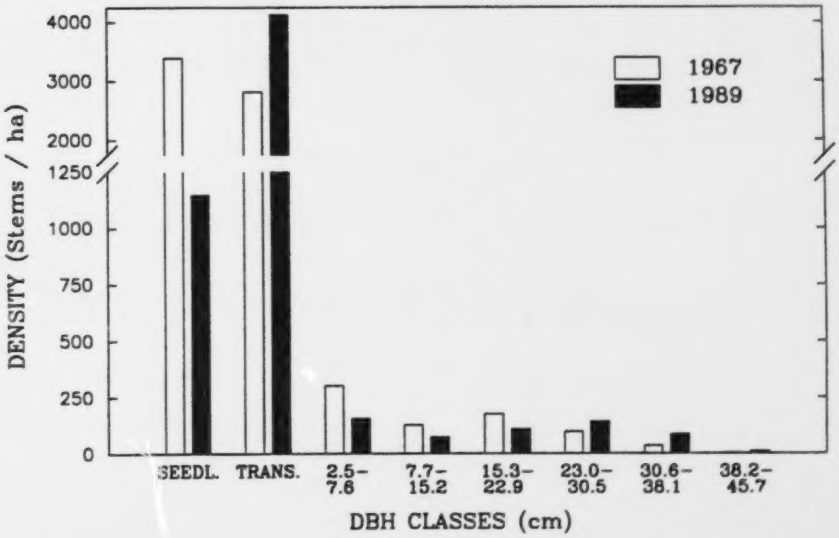


Figure 2-4. Size class distribution of all trees at Sunwapta for 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.

8 trees were survivors from the 20 individuals measured in the 1967 study; the other 5 had grown into this class in the 22 year interval. Five of the eight remaining large trees showed signs of declining health (e.g., dead crown tops, recently dead branches with brown needles).

2.3.8.2 Sunwapta

At Sunwapta, tree density in the smallest three DBH classes declined over the 22 year interval between 1967 and 1989 (Figure 2-4), despite the fact that immature *P. contorta* density remained very high at this site (Table 2-5). There was no evidence to prove that any of the transgressives inventoried in 1967 had reached the tree canopy by 1989. Observations of dead transgressives and small trees (2.5-7.6 cm DBH) revealed that most had died due to girdling by elk that often travel through the area. The elk rub their new antlers on the trees to aid in removing the felt; this abrasion scrapes the bark off the trees eventually girdling and killing them. Densities increased in the three largest DBH classes due to radial growth in trees of the three smaller DBH classes over the 22 year interval (Figure 2-4).

2.3.8.3 Whirlpool

The *Pinus contorta* size class distribution was bimodal in shape during both study years (Figure 2-6). The first mode is made up of seedlings and transgressives and the second mode is composed of trees in the 15-23 cm DBH class. Over the 22 year interval tree density has moved to the right in the graph as the trees grew in size, but the first mode has not followed it. As a result, no *Pinus contorta* trees remain in the smallest tree DBH class. In 1989 seedling density was ca. one-third that of 1967, but transgressive density was almost twice as high.

The *Picea mariana* size class distribution (Figure 2-7) shows that this species has been rapidly moving up into the tree canopy since 1967. Its density in the smallest DBH class more than tripled from 1967 to 1989 and some trees have grown into the previously unoccupied 23 - 30.5 cm DBH class. Hnatiuk found that the oldest *Picea mariana* tree at this site was about 30 years younger than the pine (Hnatiuk 1969).

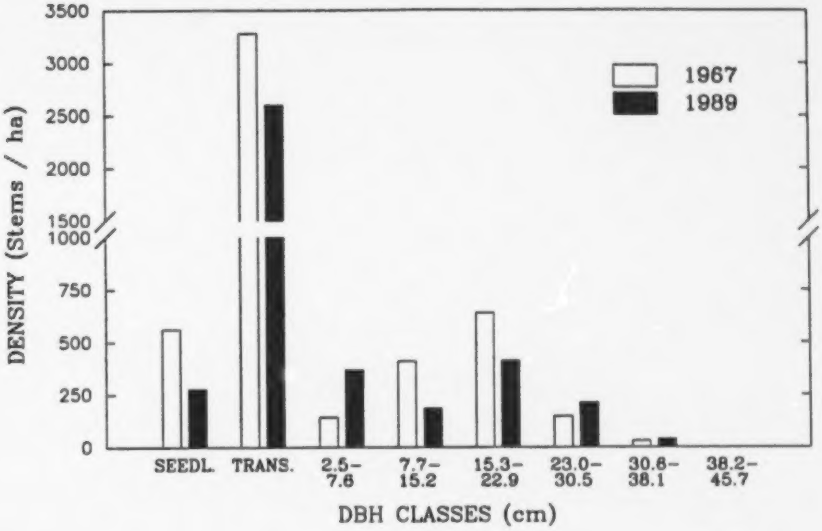


Figure 2-5. Size class distribution of all trees at Whirlpool for 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.

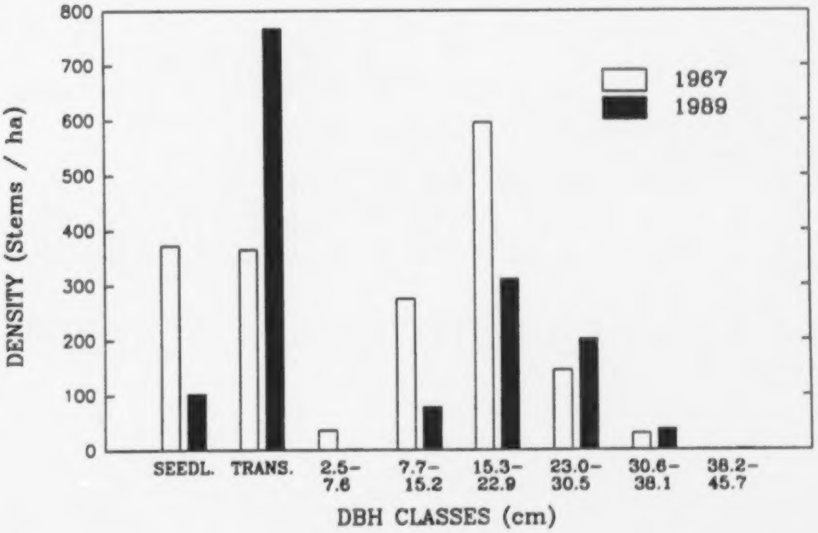


Figure 2-6. Size class distribution of *Pinus contorta* at Whirlpool for 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.

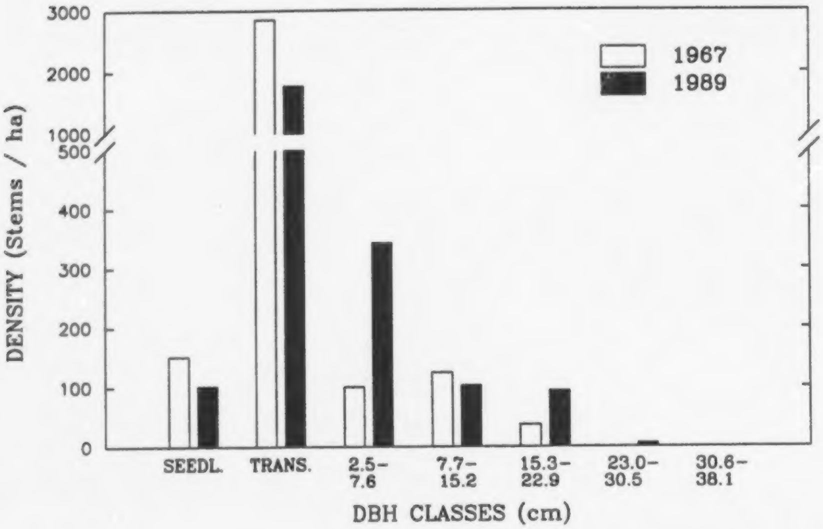


Figure 2-7. Size class distribution of *Picea mariana* at Whirlpool for 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.

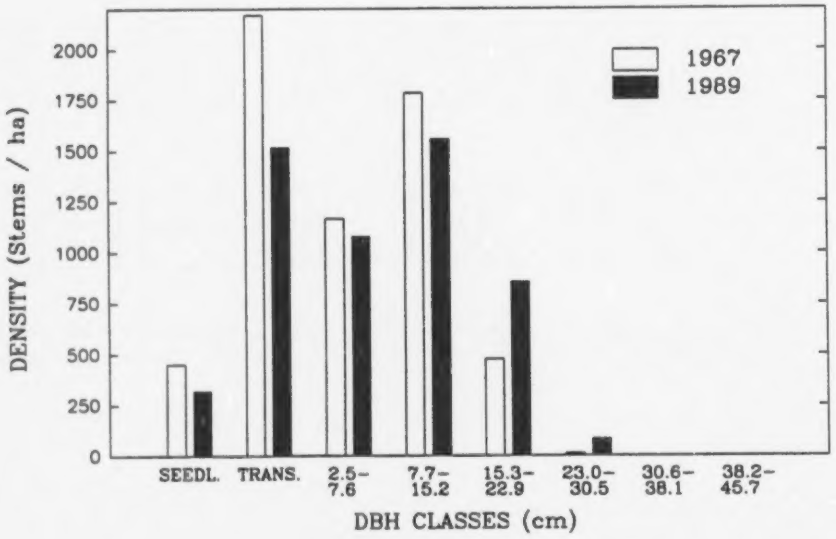


Figure 2-8. Size class distribution of all trees at Hector for 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.

2.3.8.4 Hector

None of the living trees at Hector was larger than 30.5 cm DBH (Figure 2-8) although numerous snags of larger diameter were still standing from the last fire.

The *Pinus contorta* tree population at Hector has been maturing but not reproducing, i.e., there are few seedlings and transgressives to replace mortality losses (Figure 2-9). The size class distribution moved to the right and became smaller as some trees grew into the larger DBH classes and others died since 1967.

The *Picea engelmannii* and *Abies lasiocarpa* size class distributions (Figures 2-10 and 2-11) show that both populations were beginning to enter the tree canopy in increasing numbers by 1989. Both species had relatively high densities of immature trees in both study years and their smallest DBH classes increased by factors of between 2 and 4 between 1967 and 1989. The density of *P. engelmannii* seedlings and transgressives declined between 1967 and 1989 while seedling density increased and transgressive density decreased for *A. lasiocarpa* indicating that recruitment of *P. engelmannii* is slowing more rapidly than that of *A. lasiocarpa.*

2.3.9 Tree Distribution in Stands

2.3.9.1 Athabasca

In 1967 *Pinus contorta* was found in very high densities on an old river island (Hnatiuk 1967) that runs in a SE-NW direction from the north end of the stand (Figure 2-13, see Figure 1-2 for topographical map of Athabasca). *P. contorta* density was much lower on the surrounding, more gravelly parts of the stand. Trees in the denser part of the stand belonged predominately to the smallest *P. contorta* tree DBH class, while trees in the surrounding more open areas belonged to the larger DBH classes. By 1989 the density of *P. contorta* had declined greatly on the river island but only moderately in the surrounding parts of the stand. In 1989 canopy cover distribution followed the same pattern as tree distribution, with high cover corresponding to areas of high density on the river island, and low cover corresponding to areas of lower tree density (Figure 2-12).

Pinus contorta recuitment was low on the old river island and high in the southeast area of the stand in both study years (Figure 2-13).

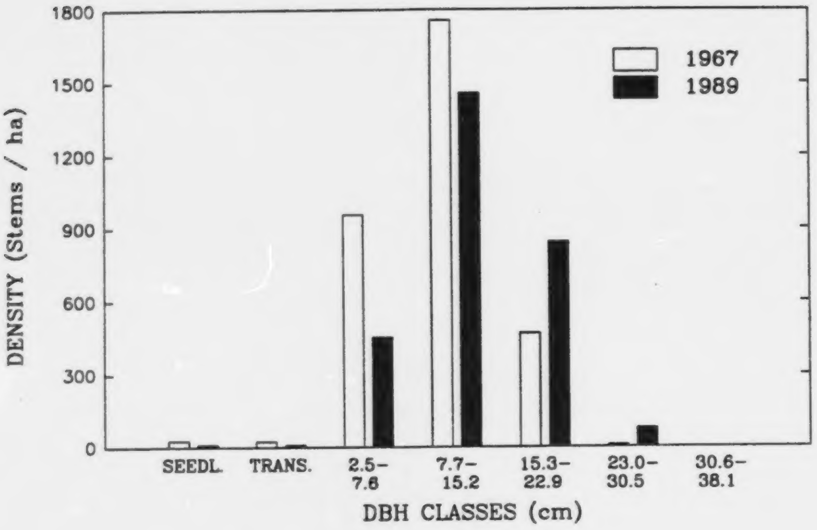


Figure 2-9. Size class distribution of *Pinus contorta* at Hector for 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.

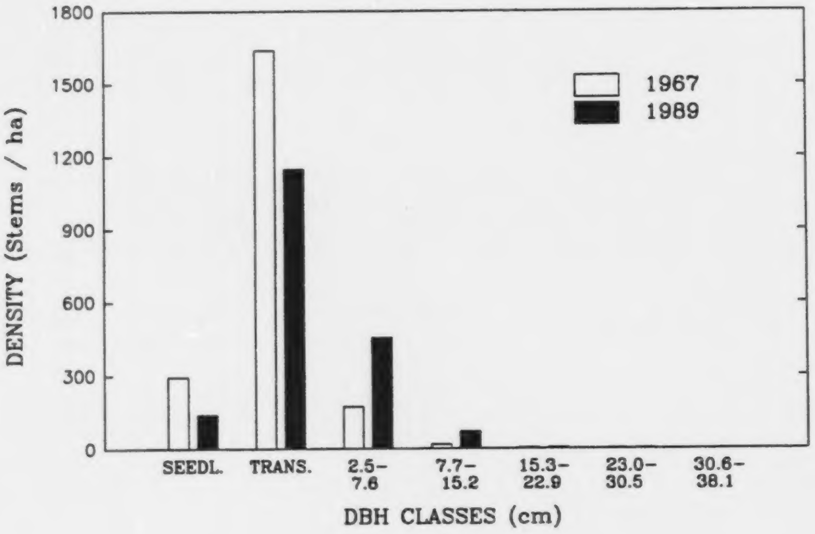


Figure 2-10. Size class distribution of *Picea engelmannii* at Hector for 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.

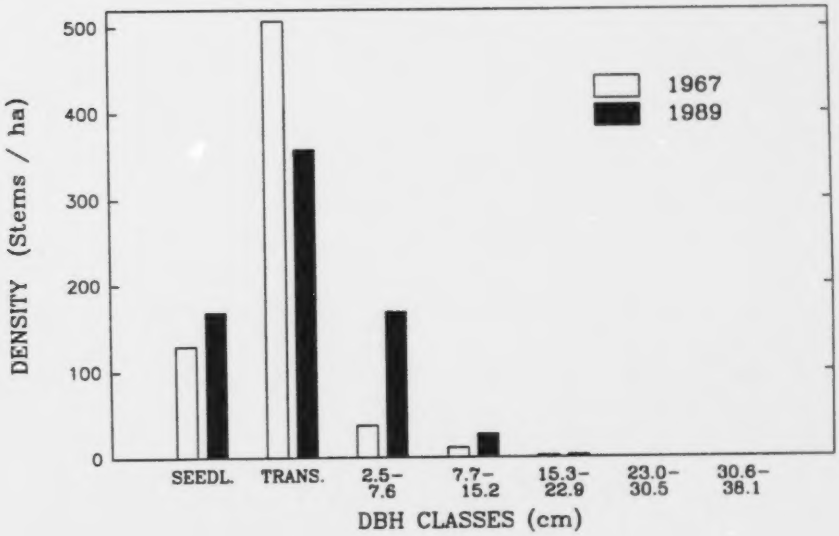
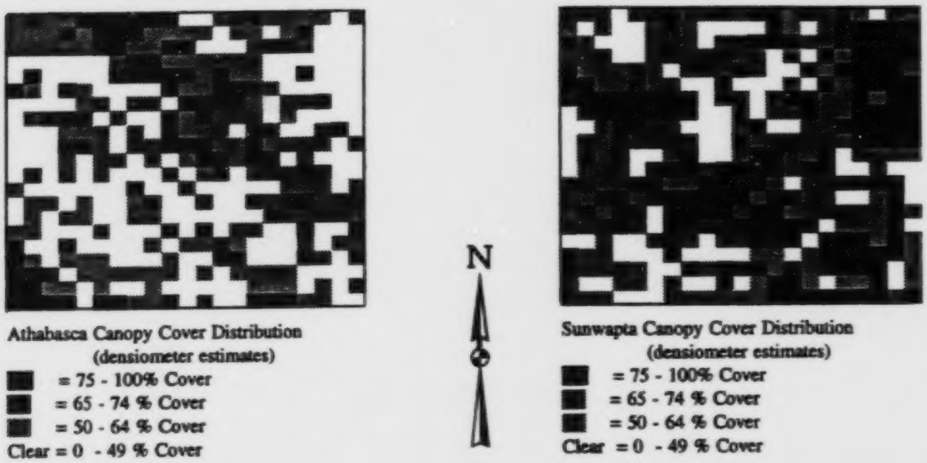
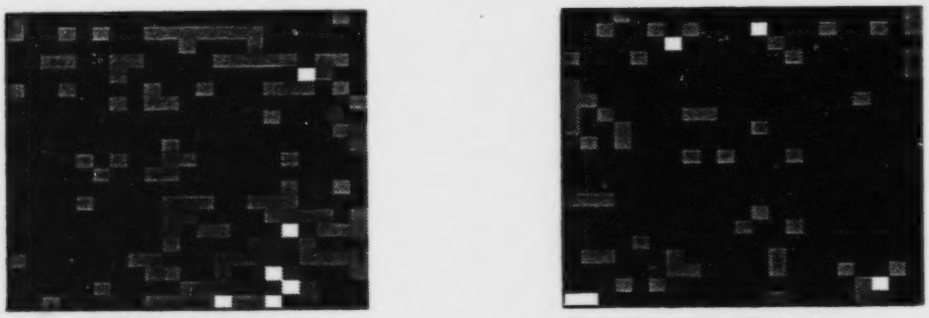


Figure 2-11. Size class distribution of *Abies lasiocarpa* at Hector in 1967 and 1989. Seedlings are <30 cm tall; transgressives are ≥30 cm tall and <2.5cm DBH.



Athabasca Canopy Cover Distribution
(densiometer estimates)
■ = 75 - 100% Cover
■ = 65 - 74 % Cover
■ = 50 - 64 % Cover
Clear = 0 - 49 % Cover

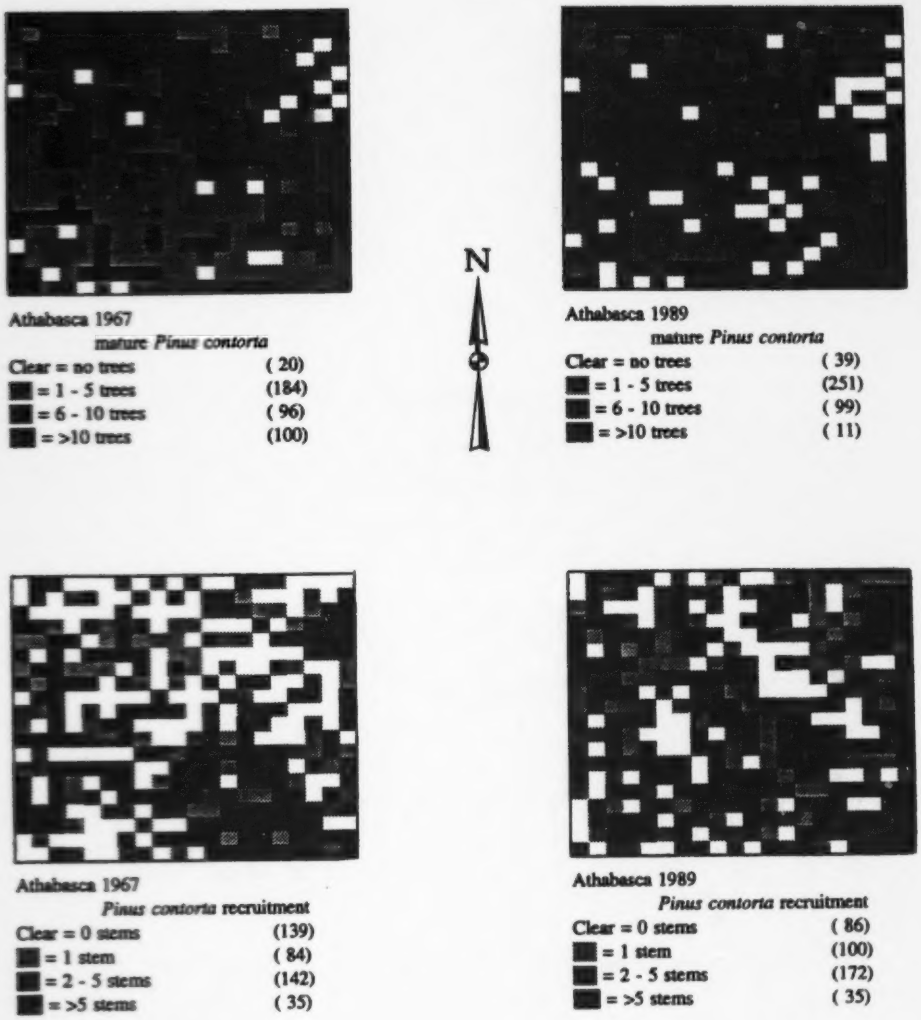
Sunwapta Canopy Cover Distribution
(densiometer estimates)
■ = 75 - 100% Cover
■ = 65 - 74 % Cover
■ = 50 - 64 % Cover
Clear = 0 - 49 % Cover



Whirlpool Canopy Cover Distribution
(densiometer estimates)
■ = 75 - 100% Cover
■ = 65 - 74 % Cover
■ = 50 - 64 % Cover
Clear = 0 - 49 % Cover

Hector Canopy Cover Distribution
(densiometer estimates)
■ = 75 - 100% Cover
■ = 65 - 74 % Cover
■ = 50 - 64 % Cover
Clear = 0 - 49 % Cover

Figure 2-12. Canopy cover at the four permanent plots in 1989 measured over quadrat corners with a densiometer.



Athabasca 1967
mature Pinus contorta

Clear = no trees	(20)
■ = 1 - 5 trees	(184)
■ = 6 - 10 trees	(96)
■ = >10 trees	(100)

Athabasca 1989
mature Pinus contorta

Clear = no trees	(39)
■ = 1 - 5 trees	(251)
■ = 6 - 10 trees	(99)
■ = >10 trees	(11)

Athabasca 1967
Pinus contorta recruitment

Clear = 0 stems	(139)
■ = 1 stem	(84)
■ = 2 - 5 stems	(142)
■ = >5 stems	(35)

Athabasca 1989
Pinus contorta recruitment

Clear = 0 stems	(86)
■ = 1 stem	(100)
■ = 2 - 5 stems	(172)
■ = >5 stems	(35)

Figure 2-13 Distribution of mature and immature *Pinus contorta* trees at Athabasca in 1967 and 1989.

2.3.9.2 Sunwapta

The distribution pattern of *P. contorta* at Sunwapta is not as clumped as at Athabasca although there is a slight concentration of trees along the south border and in the north-central area of the stand in both 1967 and 1989 (Figure 2-14). The 22 year decline in *P. contorta* density noted in Table 2-1 is difficult to see in the density distribution maps as the it occurred throughout the stand and was not localized in one area.

The areas of highest pine recruitment (Figure 2-14) appear to be associated with areas of high canopy cover (Figure 2-12).

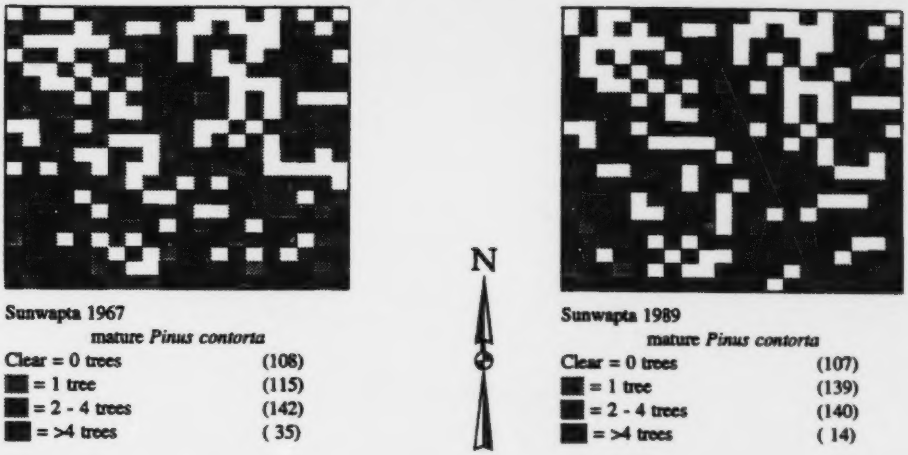
2.3.9.3 Whirlpool

The 1967 distribution of *P. contorta* at Whirlpool was fairly random although there were visibly higher densities in the western portion of the stand on the lower terrace (Figure 2-15, see Figure 1-4 for topography of the Whirlpool stand). By 1989 the number of high-density quadrats on the lower terrace was lower, such that the E-W contrast was no longer apparant. Some standing dead pine trees on this terrace had "witches brooms"; evidence of having been killed by dwarf mistletoe (*Arceuthobium americanum*) (Hiratsuka 1987). *Picea mariana* was also concentrated on the lower terrace in 1967 and although its distribution did not change significantly by 1989, its large increase in density accentuated the E-W contrast. The concentration of *P. mariana* distribution in the north-central portion of the stand on the upper terrace occurs in a depression there (Figures 1-4 and 2-15).

Canopy cover was highest on the lower terrace in 1989 (Figure 2-12). This, unlike at Sunwapta, was associated with a virtual absence of *Pinus contorta* recruitment (Figure 2-15) instead of with higher recruitment densities.

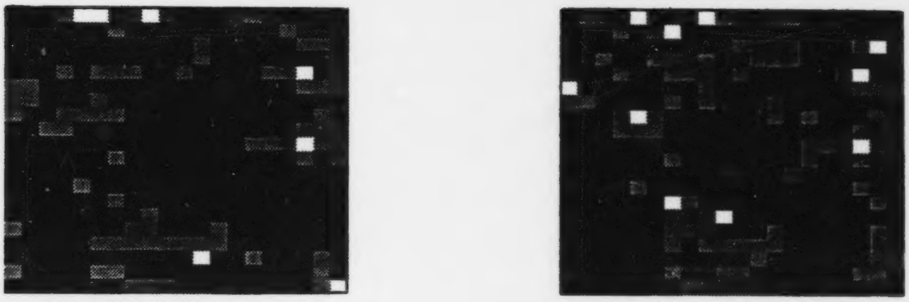
2.3.9.4 Hector

Pinus contorta increased in density along a NW to SE gradient and an up-slope direction at the Hector stand (Figure 2-16, see Figure 1-5 for topography of the Hector stand). Between 1967 and 1989 *P. contorta* density declined along the entire elevational



Sunwapta 1967
mature *Pinus contorta*
Clear = 0 trees (108)
■ = 1 tree (115)
■ = 2 - 4 trees (142)
■ = >4 trees (35)

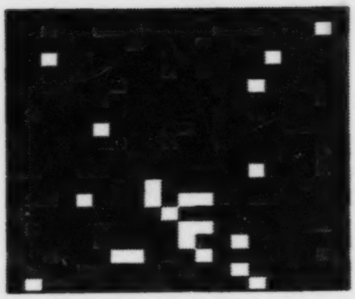
Sunwapta 1989
mature *Pinus contorta*
Clear = 0 trees (107)
■ = 1 tree (139)
■ = 2 - 4 trees (140)
■ = >4 trees (14)



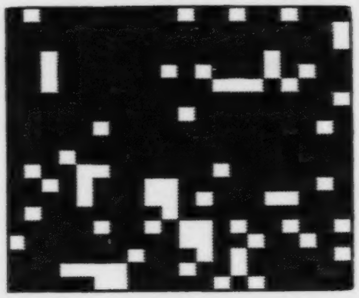
Sunwapta 1967
Pinus contorta recruitment
Clear = 0 stems (7)
■ = 1-5 stems (73)
■ = 6-15 stems (167)
■ = >15 stems (153)

Sunwapta 1989
Pinus contorta recruitment
Clear = 0 stems (10)
■ = 1-5 stems (91)
■ = 6-15 stems (170)
■ = >15 stems (129)

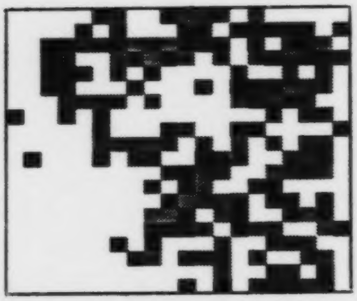
Figure 2-14. Distribution of mature and immature *Pinus contorta* trees at Sunwapta in 1967 and 1989.



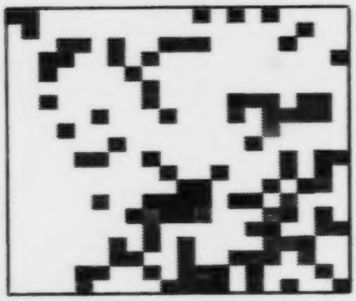
Whirlpool 1967 mature *Pinus contorta*
Clear = 0 trees (22)
▨ = 1 - 2 trees (174)
▨ = 3 - 4 trees (156)
▨ = >4 trees (48)



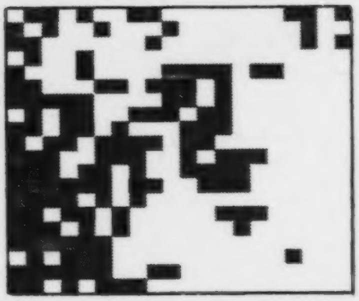
Whirlpool 1989 mature *Pinus contorta*
Clear = 0 trees (66)
▨ = 1 - 2 trees (258)
▨ = 3 - 4 trees (73)
▨ = >4 trees (3)



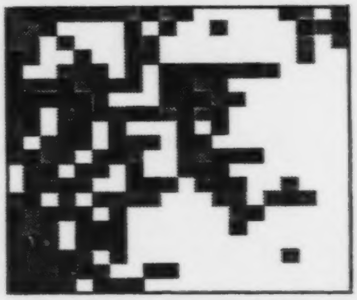
Whirlpool 1967 *Pinus contorta* recruitment
Clear = 0 trees (231)
▨ = 1 tree (73)
▨ = 2 - 4 trees (79)
▨ = >4 trees (17)



Whirlpool 1989 *Pinus contorta* recruitment
Clear = no trees (295)
▨ = 1 tree (73)
▨ = 2 - 4 trees (32)
▨ = >4 trees (0)

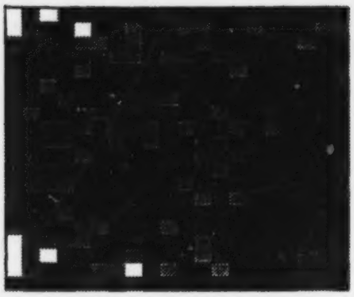


Whirlpool 1967 mature *Picea mariana*
Clear = 0 trees (255)
▨ = 1 - 2 trees (114)
▨ = 3 - 4 trees (29)
▨ = >4 trees (2)

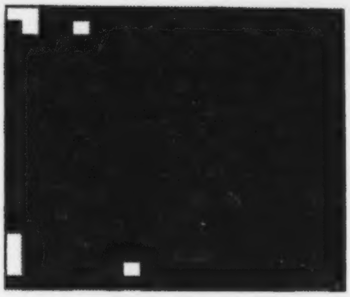


Whirlpool 1989 mature *Picea mariana*
Clear = 0 trees (215)
▨ = 1 - 2 trees (93)
▨ = 3 - 4 trees (53)
▨ = >4 trees (39)

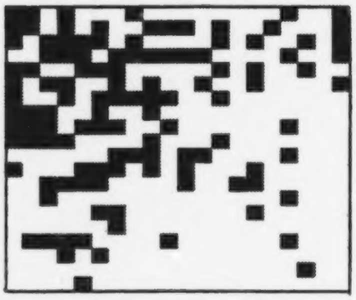
Figure 2-15. Distribution of mature and immature *Pinus contorta* and mature *Picea mariana* trees at Whirlpool in 1967 and 1989.



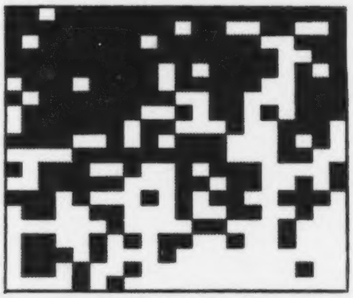
Hector 1967 *Pinus contorta*
Clear = no trees (9)
■ = 1 - 5 trees (106)
■ = 6 - 12 trees (233)
■ = <12 trees (52)



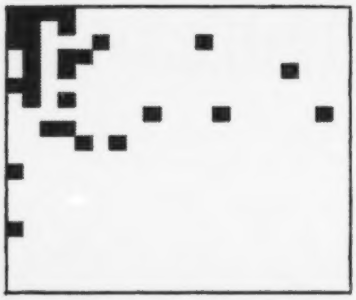
Hector 1989 *Pinus contorta*
Clear = no trees (8)
■ = 1 - 5 trees (141)
■ = 6 - 12 trees (215)
■ = >12 trees (36)



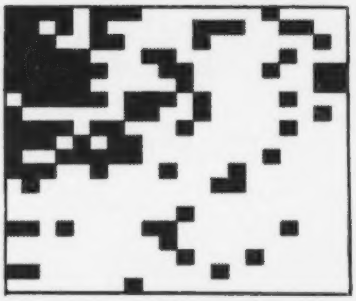
Hector 1967 *Picea engelmannii*
Clear = no trees (284)
■ = 1 - 3 trees (108)
■ = >3 trees (8)



Hector 1989 *Picea engelmannii*
Clear = no trees (175)
■ = 1 - 3 trees (182)
■ = >3 trees (43)



Hector 1967 *Abies lasiocarpa*
Clear = no trees (370)
■ = 1 - 2 trees (23)
■ = >2 trees (7)



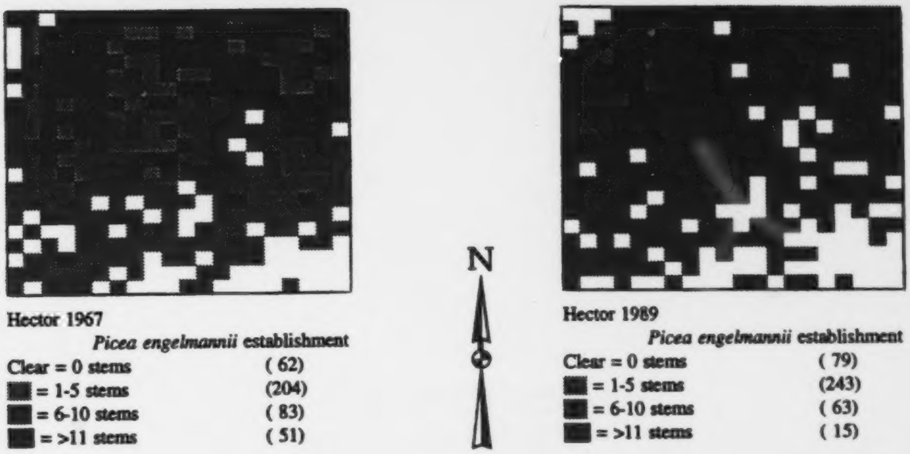
Hector 1989 *Abies lasiocarpa*
Clear = no trees (290)
■ = 1 - 2 trees (95)
■ = >2 trees (15)

Figure 2-16. Distribution of mature *Pinus contorta*, *Picea engelmannii*, and *Abies lasiocarpa* trees at Hector in 1967 and 1989.

gradient. Both *Picea engelmannii* and *Abies lasiocarpa*'s densities increased in the opposite direction, with the area of greatest density found behind an old fire margin in the northwest corner of the stand where *P. contorta* density was lowest. Between 1967 and 1989 the distributions of *P. engelmannii* and *Abies lasiocarpa* spread in a southeasterly direction into areas previously unoccupied by these species (Figure 2-16).

No clear pattern in the distribution of canopy cover could be detected at Hector. Areas of high and low cover appeared to be scattered throughout the site (Figure 2-12).

Recruitment of *Picea engelmannii* and *Abies lasiocarpa* (Figure 2-17) followed the same spatial pattern as the tree of these species, although recruitment levels dropped slightly in 1989.



Hector 1967

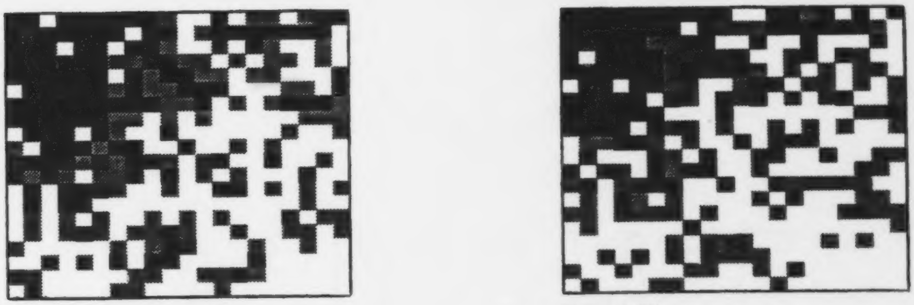
Picea engelmannii establishment

Clear = 0 stems	(62)
■ = 1-5 stems	(204)
■ = 6-10 stems	(83)
■ = >11 stems	(51)

Hector 1989

Picea engelmannii establishment

Clear = 0 stems	(79)
■ = 1-5 stems	(243)
■ = 6-10 stems	(63)
■ = >11 stems	(15)



Hector 1967

Abies lasiocarpa establishment

Clear = 0 stems	(175)
■ = 1 stem	(96)
■ = 2-5 stems	(99)
■ = >5 stems	(30)

Hector 1989

Abies lasiocarpa establishment

Clear = 0 stems	(187)
■ = 1 stem	(100)
■ = 2-5 stems	(93)
■ = >5 stems	(20)

Figure 2-17. Distribution of immature *Picea engelmannii* and *Abies lasiocarpa* trees at Hector in 1967 and 1989.

2.4 DISCUSSION

2.4.1 Measurement of Basal Area

Basal area estimates based on DBH size classes were consistently higher than those based on Bitterlich prism measurements. The latter were made from 25 randomly selected locations in each stand and therefore provided only a sampling of the stand's basal area. A very accurate inventory of basal area would be achieved if the DBH of every tree were measured and used to calculate stand basal area. Because only size classes of DBH's were available in this study the midpoints of the classes were used in the basal area determination. In the smaller tree size classes the distribution of DBH within the classes is not likely to be skewed and thus the midpoint average DBH can be used to provide a fairly accurate estimate of basal area. However, the DBHs in each site's largest size class are likely skewed towards its lower limit and thus the midpoints of this size class would provide an over-estimate of basal area. Because area is a squared function of radius, even a small over-estimation in DBH at these larger diameters results in a large over-estimation of basal area. Thus the basal areas calculated using DBH size classes are likely over-estimations of the true basal areas and the Bitterlich measurements provide more accurate estimates of stand basal area in this study. Future studies should record individual tree DBH's.

2.4.2 Athabasca and Sunwapta Sites

The two drier sites, Athabasca and Sunwapta, changed little in the species composition of their tree canopies, which remained almost exclusively *Pinus contorta* both 1967 and 1989, but they also experienced the largest declines in total tree density. They had the lowest establishment rates of tree species other than pine, likely due to the relative dryness of these two sites and hence the paucity of "safe microsites" (*sensu* Harper 1977). *Picea* spp. and *Abies lasiocarpa* apparently require more moisture than was available at these two sites to become established. Seed sources were not a problem for spruce and fir because both sites were adjacent to lower river terraces where adult, cone-bearing trees of both species were found. The total absence of *Pseudotsuga* *menziesii* establishment at Athabasca, despite the presence of adult trees on nearby ridges, may be related to a combination of poor soil nutrient conditions and low moisture levels. However, the declining tree population density at both sites require more interpretation.

Self-thinning due to overcrowding is the most plausible explanation for the dramatic decline in tree density seen at the xeric Athabasca stand. Most of the mortality occurred in the very dense "dog hair" areas of the stand which occurred on an old river island. In these areas the crowding was so intense that, despite the fact that the trees were of approximately the same age as those in less dense areas, their diameters were often half the size. Such "dog hair" stands often become established after a fire if pine regeneration is very high and will often persist until after the trees are mature. Eventually, when environmental stresses occur or total resource demands of growing trees exceed the supply, mortality will occur and the survivors will finally be able to fill out in size. This process appears to be occurring in the Athabasca stand and thus Athabasca may provide a field example of Yoda *et al*'s (1963) -3/2 Power Law where mean weight of trees increases with time and where trees of the same age have larger mean weights in sparse populations than in dense ones (Westoby 1984). The mean basal area of the trees at Athabasca did increase between 1967 and 1989, from 6.4×10^{-3} m^2/tree to 8.8×10^{-3} m^2/tree, despite the decline in basal area because the majority of the tree mortality occurred in the smallest tree size class. The decline in basal area and the low average tree height seen at this site may also be an indication that the nutrient poor and gravelly soil at Athabasca (see Chapter 1) may be severely limiting tree growth. However, a more detailed soil nutrient analysis would be required to confirm this hypothesis.

Poor nutrient conditions in the soil, low moisture levels, and the high density of adult pine trees probably all contributed to the low recruitment rate of pine at Athabasca. Stuart *et al.* (1989) found that canopy shading was not as important as competition for soil moisture in limiting pine seedling establishment in older, self-perpetuating pine stands. *P. contorta* recruitment was lowest in the dog hair area of Athabasca. In this area the high density of trees created too much shade and competed for too large a share of the resources to permit the establishment of shade-intolerant *P. contorta* seedlings.

Conditions for tree recruitment were not as limiting at the more mesic Sunwapta site where the *P. contorta* establishment rate was extremely high. Total tree basal area also increased, by ca. 3 m^2 ha^{-1}, at this site (Table 2-4). While Sunwapta tree density remained only a fraction of that at Athabasca (one-fourth in 1967 and one-third in 1989), total basal area at the two sites was, by 1989, actually higher at Sunwapta. This was because basal area declined at Athabasca, but increased at Sunwapta despite a reduction in tree density. Basal area lost at Sunwapta due to mortality in the smaller tree size classes was more than offset by radial growth of the larger trees in the site. The abundant recruitment of *P. contorta* and the increase in basal area at Sunwapta were probably due to higher soil moisture levels which was clearly evidenced by the higher understorey species diversity seen at the site (see Chapter 3). Pine recruitment was highest in quadrats with high canopy cover and low tree density (Figures 2-12 and 2-14). *Pinus contorta* recruitment is shade-intolerant, but the tree density and cover in this stand were probably low enough that shade was not a factor here. Instead, reduced evapotranspiration due to higher cover and reduced competition due to lower density may have increased soil moisture allowing abundant pine recruitment.

Despite the high *P. contorta* recruitment rate at Sunwapta, its total tree density declined significantly over the 22 years between studies and few new trees entered the canopy. Elk appear to be the cause of this as they continually girdle and kill the larger transgressives and small trees. Trees <7.5 cm in diameter are apparently just the right size to aid the elk in scraping the felt off their antlers. Thus, as the transgressives grow to become small trees they become targets of the elk and are killed, and therefore never reach the tree canopy. If the elk were excluded from this site it seems likely that pine recruitment would keep up with the mortality of adult trees and a pure pine canopy could be maintained over time.

At both Athabasca and Sunwapta the recruitment of *Picea glauca/engelmannii* and *Abies lasiocarpa* occurred at very low rates and was exceeded by *P. contorta* recruitment. Soil moisture levels at the two sites may be too low to allow abundant establishment of these non-pine tree species. It may be that for *Picea* and *Abies* species to become established on xeric and mesic sites such as found at Athabasca and Sunwapta, a series of wet years is required. This would permit development of sufficient root systems, thus reducing their vulnerability to dry conditions. However, the climate record does not reveal such a series of wet years; instead, five of the six years before 1989, and four of the six years before 1967, were below average in summer precipitation (see Figure 1-9)

Athabasca and Sunwapta may represent two different kinds of *Pinus contorta* climax forests. While *P. contorta* stands are often seral to *Picea* and *Abies* forests, climax pine forests have been reported in Yellowstone National Park (Despain 1983), the Sierra Nevada (Parker 1986), and the Cascades of Oregon (Stuart et al 1989).

2.4.3 Whirlpool and Hector Sites

The forests at both Moist sites, Whirlpool and Hector, show abundant evidence of being transitional from *P. contorta*-dominated forests to *Picea* or *Picea - Abies* forests. The pine populations declined at both sites and pine establishment at Hector was virtually non-existent. However, *Picea* and *Abies* are shade tolerant and can become established and grow well in the shade of a mature *P. contorta* canopy and the results show that this has occurred at both Whirlpool and Hector. The abundant moisture available at these sites met the conditions required for *Picea* and *Abies* establishment.

2.4.3.1 Whirlpool

Whirlpool is situated at low elevation (Table 1-1) not far from the xeric Athabasca stand from which it is distinguished by its higher rainfall. This warm but relatively wet montane environment has allowed the establishment of *Picea mariana* under the pine canopy. Recruitment of *Abies lasiocarpa* was low at Whirlpool, possibly due to the inability of this Subalpine-adapted species to compete in a Montane environment. *P. mariana* establishment was largely limited to the lower and wetter of the two terraces where most of the adult *P. mariana* trees were found as well. *P. mariana* often reproduces by layering: the lower branches of an adult tree take root and give rise to new individuals. Thus *P. mariana* establishment is highly aggregated around more mature *P. mariana* trees. The reason that mature *P. mariana* trees were more common on the lower terrace may have to do with the greater moisture availability there or to historical circumstances (e.g. proximity to riparian seed trees) that are no longer easily identifiable.

Whirlpool was the only site where the dispersion of *P. contorta* was close to regular or random instead of clumped. This may be because this stand was the oldest (150 years) of the four investigated. As a forest stand ages, self-thinning processes reduce clumping and the dispersion of surviving trees at the site may become random or even regular. Another factor involved was Lodgepole Pine Dwarf Mistletoe (*Arceuthobium americanum*), a parasitic plant, which was one of the causes of pine mortality on this terrace. The greater age of the trees in this stand may also account for the fact that total basal area decreased (Table 2-4) despite apparently good moisture and soil conditions.

P. contorta establishment was largely restricted to the upper terrace where the moss cover was lower and where competition from *Picea mariana* was less intense (Figure 2-13). Even there, *P. contorta* establishment was restricted to quadrats with few or no mature trees in 1967 (Spearman's ranked correlation coefficient between mature and establishment pine was r_s = -0.33; see Table 3-11), which was likely a result of its intolerance to shade.

The accentuation of the bimodal size class distribution of the *P. contorta* population over the 22 year interval indicates that virtually none of the pine recruitment grew into the canopy during this period. *P. contorta* seedling establishment continued, but none of these seedlings was able to grow past the transgressive stage. The reason for this "block" to the growth of pine transgressives is not clear (cf. Sunwapta where elk are clearly implicated) but it may be that the pine canopy overhead was still too dense and casting too much shade to allow these transgressives to grow into the canopy. The transgressives may survive for an extended period of time in this stunted form until the canopy opens up enough through mortality and wind throw and frees up the resources required for their renewed growth (Hnatiuk 1969).

In the long term the lower terrace at Whirlpool will almost certainly become dominated by *Picea mariana*. This is consistent with Laidlaw's (1971) finding that *P. contorta* is seral to *P. mariana* in lower-elevation wet environments of the Canadian Rockies. *Populus tremuloides* will soon disappear from the site as senescence continues and recruitment fails. The upper terrace will likely develop into more of a *P. contorta* -

P. mariana mixed forest with a minor *Abies* element as mortality continues in the original cohort of mature pines. Hnatiuk (1969) postulated that because of *P. mariana*'s shorter life-span, Whirlpool will, in the absence of fire, develop into a *Picea glauca/engelmannii-Abies lasiocarpa* forest. However, the longevity of *P. contorta* and the abundant, although suppressed, pine recruitment suggest that in the absence of fire *P. contorta* will remain an important component of the upper terrace.

2.4.3.2 Hector

Hector had the highest total tree density of the four sites and was also the only one where total density increased over the study period (Table 2-1). This may have been related to high moisture levels and better soil nutrient conditions which allowed higher allocations of resources to individual trees. The population density of *Pinus contorta* declined at Hector, though not as much as at the other three sites. Basal area of *P. contorta* increased slightly as growth in the surviving trees compensated for losses to mortality. *P. contorta* recruitment was virtually non-existent. The high tree density, competition from a dense shrub stratum, and the absence of exposed mineral soil were all probable factors preventing pine establishment. However, *Picea engelmannii* and *Abies lasiocarpa* are both shade tolerant and are well adapted to establishment under a dense tree canopy such as exists at Hector. Both appear to be better adapted to grow in this cooler, higher-elevation site than in the other three lower-elevation sites.

Immature *Picea engelmannii* and *Abies lasiocarpa* were most abundant near the fire margin at the north-west corner of the site where mature seed trees of these species were most common. This area of successful establishment has spread southeast and uphill over the 22 year interval. It is clear that, given no major external disturbance such as fire, the forest at Hector will eventually become a *Picea - Abies* forest typical of the subalpine zone (Beil 1966).

2.4.4 Conclusions

This study has shown that (1) patterns of tree population dynamics within *Pinus contorta* dominated stands vary considerably among sites, and (2) site-specific factors may be more important to the future development of stands than their original (i.e., post-disturbance) tree species composition. Moisture availability appears to be the most important site-specific factor determining future successional dynamics in the tree canopy. The two drier sites, Athabasca and Sunwapta, will remain dominated by pine for the foreseeable future because little establishment by other tree species is occurring in them, despite the presence of nearby seed trees. In contrast, Whirlpool and Hector have sufficient moisture to permit development to *P. contorta-Picea mariana* and *Picea engelmannii-Abies lasiocarpa* forests, respectively. Plentiful soil moisture is crucial for the establishment of seedlings of *Picea* and *Abies*, thus sites where moisture availability is too low will most probably remain dominated by pine.

Entry of *P. contorta* into the tree canopy at sites where pine establishment is abundant is limited by other site-specific variables such as light availability and animal disturbances which affect the growth and mortality rates of pine establishment. Therefore one cannot confidently predict the future size class distribution and structural make-up of tree canopies on these sites based on what is presently known. Abundant pine regeneration under a pine canopy does not necessarily mean that maintenance of the present canopy structure is assured in the future.

The importance of site-specific factors in the ongoing development of a forest canopy and the failure of size class distribution curves to predict future stand composition reliably indicates the continuing need for permanent reference stands in the study of forest stand dynamics in the Alberta Rocky Mountains.

By subdividing permanent plots into smaller units that are unquestionably smaller than the average size of disturbance patches, and by then monitoring the composition and structure of all of these units at suitable time intervals, it is possible to document both stand and patch dynamic changes. At the Athabasca and Whirlpool sites it is clear that the dynamics of *P. contorta* mortality and *Picea* invasion occurred at a scale smaller than the size of the whole plot. Because the sites were subdivided into contiguous quadrats it was possible to locate these events within the stands and to make causal hypotheses for the factors affecting these events (tree density, local topography, and moisture availability).

The results reported here show that changes in the plant community attributes of 5 × 5 m quadrats and the larger 100 × 100 m reference stands they compose can help us describe, interpret, and better understand the local and global ecological dynamics of mountain forest ecosystems in Banff and Jasper National Parks.

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CHAPTER 3. UNDERSTOREY VEGETATION DYNAMICS

3.1 INTRODUCTION

In many studies of forest ecosystems, especially in North America, the importance of the understorey is either underestimated or ignored, and most of the attention is given to the dominant tree canopy species. However, it has become increasingly clear that in many temperate and boreal forest ecosystems the understorey plays a significant role in nutrient cycling (Yarie 1980), and that understorey vegetation can be a good indicator of site quality and available soil nutrients (e.g., in *Pinus contorta* - dominated forests of the Alberta foothills (Corns 1983; La Roi *et al.* 1988)). Understorey species also compete for resources with seedlings and saplings of tree species and provide forage for forest animals. Thus, in a study of the dynamics of a forest ecosystem, an understanding of the structure, diversity, and dynamics of the understorey vegetation is crucial.

Understorey vegetation in forests of the central Canadian Rocky Mountains is similar in many ways to that found in the boreal forest. The higher elevations, and resulting cooler temperatures, in the mountains allow the southward extension of many boreal forest species. However, greater influence of Pacific climatic systems, unique local climate conditions caused by mountain topography, differing geological substrata, and the lack of extensive wetland areas due to good drainage have resulted in Cordilleran forest understorey vegetation with many unique characteristics.

In Roger Hnatiuk's general survey of the *Pinus contorta* forests of Banff and Jasper National Parks, nine different vegetation types were described and separated into three moisture classes (Hnatiuk 1969). The three moisture classes were subdivided on the basis of their understorey vegetation. In the Moist Forest Class, four types were described: 1) *Menziesia ferruginea* type (then *M. glabella*), 2) *Alnus crispa* type, 3) feather moss type, and 4) *Vaccinium scoparium* type. In the Mesophytic Forest Class, three types were described: 5) Mesophytic high subalpine forests, 6) *Shepherdia canadensis* type, and 7) *Elymus innovatus* type. In the Xerophytic Forest Class one type was described: 8) *Arctostaphylos uva-ursi*. Unclassified forest stands were grouped into a ninth "residual stands" type (Hnatiuk 1969).

Hnatiuk established five - 1 hectare permanent plots to represent five of these types; four of these were re-established for the present study. In the Moist Forest Class the *Menziesia ferruginea* type (Hector site) and feather moss type (Whirlpool site) are represented; the *Shepherdia canadensis* type (Sunwapta site) represents the Mesophytic Forest Class; and the *Arctostaphylos uva-ursi* type (Athabasca site) represents the Xerophytic Forest Class (see Table 1-1).

Using the same data collected by Hnatiuk in the general stand survey, but using more rigorous classification methods, La Roi and Hnatiuk (1980) recognized five "community types": P. CONTORTA/S. CANADENSIS/A. UVA-URSI, P. CONTORTA/S. CANADENSIS/E. INNOVATUS, P. CONTORTA/ALNUS CRISPA/LINNAEA BOREALIS, P. CONTORTA/M. GLABELLA/V. SCOPARIUM and P. CONTORTA/LEDUM GROENLANDICUM/V. SCOPARIUM.

In the 1970's an ecological (biophysical) land classification was developed for Banff and Jasper National Parks. I.G.W. Corns and P.L. Achuff classified the vegetation of the two parks into units called "vegetation types" which they describe as having the same order of magnitude as the "association" of the Zürich-Montpellier school (Holland and Coen 1982, Westhoff and van der Maarel 1973). The successional status of each vegetation type, and the likely successional relationships between different vegetation types, were determined in this ecological classification.

The three major objectives of this portion of the study are: 1) to describe and compare the species composition, cover, diversity, and distribution in the understorey strata of four pine dominated communities sampled in 1967 and 1989; 2) to attempt to relate understorey changes from 1967 and 1989 to topography, moisture regime, or site history characteristics; and 3) to evaluate the successional status and temporal stability of these four forest communities based on dynamic changes observed between 1967 and 1989. Also, vegetation data collected from the four stands in 1967 and 1989 will be used to assign them to the appropriate "community type" of La Roi and Hnatiuk (1980) and "vegetation type" of Holland and Coen (1982). Finally, predictions will be made on future successional trends based on relevant literature and specific results obtained in this study.

3.2 METHODS

3.2.1 Field Methods

The study involved the re-establishment of four of R. Hnatiuk's five one-hectare plots and the gridding of each plot into 400 5 x 5 m quadrats. Hnatiuk's site on the Spray River in southern Banff National Park had to be omitted because it became relatively inaccessible following the closure of the Spray River fire road. The sites were relocated using a metal detector to find the railway spikes Hnatiuk had used to mark them in 1967. The re-established quadrats were delimited with wooden stakes and string and corresponded precisely to those Hnatiuk had established in 1967.

In each of the 400 5 x 5 m quadrats in each permanent reference stand, ocular cover estimates were made for all understorey vascular plant and non-vascular (i.e., bryophyte and lichen) species. Cover was estimated to the nearest percent integer. Species covers less than 1 percent were classed as either "common" or "rare" and were given numeric equivalents of 0.5% and 0.1% respectively.

The grid at each site was also subdivided into 25 20 x 20 m blocks each containing 16 quadrats. Hnatiuk had randomly selected a single quadrat from each block in 1967 and these same 25 quadrats per site were selected for the 1989 study. The following procedure was carried out in each of these quadrats.

Point cover was determined using 25 randomly selected points distributed along each of 4 randomly placed east-west 5 m lines (Hnatiuk 1969). Sampling was carried out by lowering knitting needles (No. 14 or 2 mm diameter) vertically to the ground below a metric tape and recording by species the plants touched by the needle. This procedure was only carried out in the xeric Athabasca and moist Hector sites as not enough time was available to use it at all four sites.

3.2.2 Laboratory

The 1989 ocular cover data were entered onto Lotus 1-2-3 (Version 3.0) computer files. Comparable data from Hnatiuk's 1967 study were entered onto similar files.

Hnatiuk estimated understorey species cover using a variation of the Braun-Blanquet cover class system (Table 3-1; Braun-Blanquet 1932, Hnatiuk 1969). In order to compare the 1967 and 1989 data sets without systematic bias, the Braun-Blanquet cover estimates were converted to percentage values using the midpoints of cover classes. The 1989 cover estimates, which were recorded to the nearest integer, were first converted to Braun-Blanquet cover classes and then treated as per those of 1967 (Table 3-1). This procedure resulted in a loss of resolution in the cover estimates made in 1989. Comparisons of total species in the 400 quadrats at each site revealed proportionate errors of 1 to 8 percent between the unconverted percent data set and the converted midpoint data set (see Table 3-5).

Table 3-1. The mid-point equivalents to the modified Braun-Blanquet cover class system used in 1967 and the percentages recorded in 1989.

Braun-Blanquet Class	**Percent Cover Range**	**Mid-Point**
Rare (r)	0.1	0.1
Common (+)	0.5	0.5
1	1 - 5	3
2	6 - 15	10
3	16 - 25	20
4	26 - 50	38
5	51 - 75	63
6	76 - 100	88

Means and standard statistics of understorey species cover, Simpson's and Shannon-Weaver diversity indices, and species structure curves showing species dominance hierarchies (La Roi *et al.* 1987) were determined for each stand. The formula for Simpson's index, which measures dominance concentration, is as follows:

$$D=\sum_{i=0}^{s}(p_i)^2$$

where s is the total number of vascular species in the sample, and p_i is the proportion of all individuals in the sample (i.e., the sum of all the vascular species cover values) that belong to species i (Simpson 1949)

A variation of Simpson's index which measures equitability is $E = D/D_{max}$ where $D_{max} = 1 - 1/s$.

The formula for the Shannon Weaver index of species diversity (Shannon and Weaver 1949), also known as Shannon-Wiener index, is:

$$H'=-\sum_{i=1}^{s}(p_i)(\ln p_i)$$

In order to detect and assess observer-related differences in estimating the cover of the understorey species by the researchers in 1967 and 1989, the following procedure was carried out. It was assumed that the point sampling method of estimating species cover (Greig-Smith 1982) was relatively observer-independent and could thus provide a standard for comparing the ocular cover estimates of the two researchers. The species cover values determined by point sampling in the 25 intensively sampled quadrats (see 3.2.1 above) were compared to the values determined by ocular estimates in the same quadrats. Since the 1967 ocular cover estimates had been recorded as Braun-Blanquet cover classes, the 1989 ocular integer cover data had to be converted to cover classes as well. The results appear in Table 3-2.

The Braun-Blanquet cover class system is not linear, with large differences in the cover ranges included in each class, so only the direction, not the degree, of estimation error could be determined. The direction of the difference between ocular and point estimates of cover were recorded for each quadrat in both the 1967 and 1989 intensive quadrat data sets. A Chi-square goodness of fit test was then carried out for each species to determine whether or not the estimation error was independent of the researcher. The results of the analysis were used in interpreting the significance of changes in species cover between 1967 and 1989.

Correlation coefficients between the cover estimates of all the understorey species were calculated for all 400 quadrats of a particular site for each of the two study years. The densities of mature and immature stems the dominant tree species were included in the correlation matrix for each site and study year (for collection methodology of tree data see Chapter 2). Spearman's rank-order correlation coefficient was used as it is a non-parametric measure and the species cover data were not normally distributed. Zar (1984) suggested that the performance of Spearman's coefficient is better than Kendall's tau (another non-parametric statistic) when n is large. The CORR procedure of the SAS (Version 6.06) statistical programme was used to calculate these correlation coefficients.

Correlation coefficients between the cover of understorey species in 1967 and 1989 were determined in the same way for all four sites. These correlation coefficients provide a measure of the stability of understorey species over the 22 year interval.

Indices of similarity between the four understorey communities were calculated in order to estimate ß diversity (Whittaker 1975; Wolda 1981). The Jaccard index (1912), which depends on the presence and absence of species (qualitative data) was calculated using the equation

$$C_J = \frac{c}{(a+b-c)}$$

where *c*= the number of species common to both sites, *a*= the number of species in site A, and *b*= the number of species in site B (Magurran 1988).

The quantitative version of the Sørenson index was calculated using the equation

$$C_S = \frac{2cN}{(aN+bN)}$$

where *aN*= the total cover of species in site A, *bN*= the total cover of species in site B, and *cN*= the sum of the lower of the two covers of species which occur in both sites

(Bray and Curtis 1957).

A quadrat classification using pooled 1967 and 1989 vascular species cover data was performed for each site. The CLUSTER procedure of SAS (Version 6.06) was used to divide the quadrats at each site into five classes. A stepwise discriminant analysis (STEPDISC procedure in SAS) was then used to determine the species weightings (partial r^2) in the classifications. The covers of the species with the highest weightings in each classification were then used to provide a description for the classification units. Transition matrices (Horn 1975; Usher 1979 and 1981) between understorey quadrat classes in 1967 and 1989 were created for each site to demonstrate the fate of the 1967 classes (e.g., of the *n* quadrats belonging to class *X* in 1967, *a* occurred in class *X*, *b* in class *Y*, and *c* in class *Z* in 1989).

Species nomenclature follows Moss (1983).

3.3 RESULTS

3.3.1 Observer Differences In Ocular Cover Estimation

Differences in estimating understorey species cover by the researchers in 1967 and 1989 are summarized in Table 3-2. Although species estimates from only two of the four sites could be compared, most of the important understorey species were included. Important differences in estimation of understorey species cover include an overestimation of *Arctostaphylos uva-ursi*, a slightly significant overestimation of *Juniperus communis* and *Rosa acicularis*, and an underestimation of *Shepherdia canadensis* in 1989 at the Athabasca site. At Hector, *Menziesia ferruginea* was underestimated while *Pleurozium schreberi* was overestimated in 1989. Hnatiuk's ocular estimates of *M. ferruginea* cover in 1967 were close to the point sample estimates whereas my ocular estimates were only half the point sample estimates: in contrast, my ocular estimates of *Pleurozium schreberi* were much closer than Hnatiuk's to the point sample estimates. (Table 3-2). While the ocular estimates of *S. canadensis* and *J. communis* cover at Athabasca were significantly different between 1967 and 1989 ($p<0.05$), the estimation differences between each of the ocular estimates and their respective point estimates were less than 1 percent (Table 3-2).

3.3.2 Species Composition, Cover, and Diversity of the Understorey

The understorey vascular flora of the four permanent reference stands was composed of 71 species in 1967 and 71 species in 1989, which can be compiled into a complete list of 78 species, belonging to 63 genera and 28 families (Table 3-3 and 3-4). In terms of major plant growth-forms, there were 15 shrubs, 10 dwarf shrubs, 43 forbs, 8 graminoids, and 2 pteridophytes.

Dramatic increases in the cover of vascular understorey growth-forms and many species occurred in all the reference stands except Hector, where a modest decrease in cover was recorded (Table 3-3 and 3-5). However, frequency of species occurrence did not follow this same pattern as it was very stable between the two study years for many of the major understorey species (Table 3-4). Species richness was little changed in 1989

Table 3-2. 1967 and 1989 ocular and point-sampling estimates[t] of mean percent cover of major plant species in the Athabasca and Hector reference stands, based on paired subsamples of randomly selected 5x5 m quadrats. Note that the significance attributed to each species refers to whether there was a significant difference in the direction (not the degree) of estimation error between 1967 and 1989 (see Methods section 3.2.2).

	1967			1989			
	OCULAR	POINT	ESTIMATION DIFFERENCE	OCULAR	POINT	ESTIMATION DIFFERENCE	SIGNIF.
ATHABASCA							
Shepherdia canadensis	1.2	0.9	+ 0.3	8.5	8.8	- 0.3	S^{**}
Juniperus communis	0.2	0.6	- 0.5	1.1	0.9	+ 0.2	S^{*}
Rosa acicularis	0.1	1.7	- 1.5	3.4	4.3	- 0.9	S^{*}
Arctostaphylos uva-ursi	11.5	30.6	-19.2	27.0	33.3	- 6.3	S^{**}
Linnaea borealis	1.7	5.3	- 3.6	5.8	5.5	+ 0.3	NS
Fragaria virginiana	0.1	2.2	- 2.1	1.7	2.4	- 0.7	NS
Elymus innovatus	0.3	7.6	- 7.4	9.2	13.0	- 3.8	NS
Moss species	7.0	19.8	-12.9	9.6	16.8	- 7.2	NS
Lichen species	3.1	4.7	- 1.7	6.4	2.1	+ 4.3	S^{**}
HECTOR							
Menziesia ferruginea	33.0	31.6	+ 1.3	11.7	21.6	- 9.9	S^{**}
Shepherdia canadensis	2.6	4.8	- 2.2	1.7	3.3	- 1.6	NS
Linnaea borealis	0.2	2.0	- 1.9	0.3	1.9	- 1.6	NS
Vaccinium myrtillus	0.3	0.9	- 0.6	0.2	0.9	- 0.7	NS
Vaccinium scoparium	1.9	7.2	- 5.3	1.6	5.5	- 3.9	NS
Pleurozium schreberi	3.5	20.2	-16.7	34.0	38.8	- 4.9	S^{**}
Dicranum polysetum	0.3	1.9	- 1.6	0.4	2.9	- 2.5	NS
Peltigera species	1.0	6.7	- 5.7	1.2	4.7	- 3.4	NS
Cladonia species	0.9	10.2	- 9.3	0.2	3.5	- 3.3	S^{**}

S - Significant
NS - Not significant
* - probability < 0.05
** - probability < 0.01
[t] - see Methods. 1967 estimates by R. Hnatiuk, 1989 estimates by J. Stadt.

Table 3-3. Mean percent cover of understorey plant growth-forms and species based on ocular estimates in 400 quadrats. Estimates based on midpoints of Braun-Blanquet cover classes (see Methods and Table 3-1). "+" indicates < 0.01 but > 0 %.

SPECIES	ATHABASCA		SUNWAPTA		WHIRLPOOL		HECTOR	
	1967	1989	1967	1989	1967	1989	1967	1989
SHRUBS	**1.15**	**12.79**	**10.77**	**15.17**	**1.07**	**7.96**	**35.55**	**29.32**
Shepherdia canadensis	0.72	7.68	9.39	9.77	0.37	5.35	3.44	2.30
Ledum groenlandicum			0.01	0.04	0.02	0.11	0.18	0.21
Menziesia ferruginea			0.01	0.03			31.77	26.72
Rhododendron albiflorum			+	+			0.10	0.05
Lonicera dioica	+	+						
Lonicera involucrata			+			+	0.01	0.01
Amelanchier alnifolia	0.01	0.02	+		+			
Sorbus scopulina					+	+		
Spiraea betulifolia	+				0.02	0.05	0.01	+
Juniperus communis	0.29	2.34	1.13	4.75	0.57	1.88	0.03	0.02
Rosa acicularis	0.13	2.74	0.20	0.50	0.09	0.56		
Salix spp.	0.01	0.01	0.02	0.02	+	0.01	0.01	+
Alnus crispa			0.01	0.06	+	0.01		
Ribes lacustre							+	+
Vibernum edule				+	0.01	0.02		
DWARF SHRUBS	**9.39**	**32.40**	**1.68**	**8.15**	**2.11**	**8.54**	**2.41**	**1.90**
Arctostaphylos uva-ursi	8.63	26.95	0.42	2.09	0.37	2.30		
Linnaea borealis	0.76	5.45	0.81	4.06	1.08	3.16	0.14	0.34
Cassiope mertensiana				+				
Phyllodoce empetriformis			+	0.02				
Vaccinium caespitosum			0.34	1.34	0.64	3.02		
Vaccinium membranaceum					+			
Vaccinium myrtillus			+	0.02			0.40	0.11
Vaccinium scoparium			0.04		0.01	0.03	1.86	1.45
Vaccinium vitis-idaea			0.07	0.62				
Juniperus horizontalis		+	+	0.01				
FORBS	**0.68**	**2.30**	**1.18**	**2.72**	**1.14**	**5.83**	**0.62**	**1.16**
Fragaria virginiana	0.12	1.78	0.20	1.23	0.01	0.10	+	+
Geum triflorum	+							
Potentilla fruticosa	+							
Rubus pubescens						+		
Chimaphila umbellata			0.03	0.04	0.01	0.03		
Orthilia secunda	0.04	0.02	0.12	0.20	0.08	0.19	0.03	0.02
Pyrola chlorantha	0.08	0.03	0.09	0.08	0.05	0.03	+	+
Cornus canadensis			0.07	0.38	0.75	4.48	0.04	0.26
Achillea millefolium	0.10	0.10	0.02	0.01	0.01	0.01		
Agoseris spp.			0.01	+		+		
Antennaria howellii	0.07	0.09	0.09	0.05				
Antennaria rosea	0.01	0.01	0.03	+	+			
Arnica cordifolia			0.04	0.05	0.07	0.58	0.48	0.84
Aster ciliolatus	+		0.02	0.02	+	0.01		+
Aster conspicuus			0.04	0.07	0.06	0.21		
Hieracium cynoglossoides	+		+					
Senecio streptanthifolius	0.05	0.09	0.03	0.03				
Solidago spp.	0.12	0.10	0.06	0.03	0.01	0.02		
Taraxacum officinale		+						
Castilleja miniata		+	0.01	0.01				
Melampyrum lineare			0.24	0.47				
Stellaria longipes	+							
Geocaulon lividum			+	0.01	0.02	0.12		
Viola adunca	0.04	0.05			+	+		

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Table 3-3. Continued.

SPECIES	**ATHABASCA**		**SUNWAPTA**		**WHIRLPOOL**		**HECTOR**	
	1967	**1989**	**1967**	**1989**	**1967**	**1989**	**1967**	**1989**
Campanula rotundifolia	0.02	0.01			0.01	0.01		
Epilobium angustifolium			0.01	0.02	0.01	0.01	0.05	0.03
Gentianella amarella	0.04	0.02	0.05	0.01				
Gentianella propinqua				+				
Lathyrus ochroleucus					0.01	0.02		
Vicia americana		+						
Trifolium repens		+	+		+	+		
Empetrum nigrum							0.02	0.01
Anemone multifida	+	+	+					
Anemone lithophila				+				
Zigadenus elegans						+		
Calypso bulbosa	0.01	0.02	0.01	+	0.02	0.01		
Corallorhiza trifida		+	0.01	+	+			
Goodyera oblongifolia			0.02	0.04	0.01	0.02	+	
Habenaria obtusata			+	0.01	+			
Habenaria orbiculata						+		
Habenaria unalascensis			+	+				
Habenaria viridis		+						
Listera cordata			+	+	+		+	
PTERIDOPHYTES	**0**	**0**	**+**	**0.07**	**+**	**0.12**	**+**	**+**
Lycopodium annotinum					+	0.01	+	+
Lycopodium complanatum			+	0.07		0.11		
GRAMINOIDS	**0.67**	**8.90**	**0.37**	**3.21**	**0.19**	**3.51**	**0.06**	**0.01**
Bromus inermis	+							
Calamagrostis purpurescens	0.03	0.02						
Elymus innovatus	0.20	8.80	0.36	3.21	0.19	3.51	+	+
Festuca saximontana	0.05	0.04						
Festuca scabrella			+					
Poa spp.			+					
Trisetum spicatum			0.01		+	+		
Carex spp.	0.40	0.03	+				0.06	0.01

Table 3-4. Frequency of occurrence of understorey species at the four reference stands in 1967 and 1989 out of the 400 quadrats inventoried at each stand.

SPECIES	**ATHABASCA**		**SUNWAPTA**		**WHIRLPOOL**		**HECTOR**	
	1967	**1989**	**1967**	**1989**	**1967**	**1989**	**1967**	**1989**
SHRUBS								
Shepherdia canadensis	318	388	397	400	352	363	283	297
Ledum groenlandicum			10	14	22	20	179	190
Menziesia ferruginea			20	22			385	387
Rhododendron albiflorum			3	1			20	15
Lonicera dioica	1	1						
Lonicera involucrata			2			1	41	21
Amelanchier alnifolia	21	15	6		10			
Sorbus scopulina					1	1		
Spiraea betulifolia	2				64	67	11	7
Juniperus communis	118	287	359	370	191	251	39	32
Rosa acicularis	341	353	341	331	335	332		
Salix spp.	14	18	67	43	16	16	29	16
Alnus crispa			7	7	1	3		
Ribes lacustre							3	2
Viburnum edule				1	16	16		
DWARF SHRUBS								
Arctostaphylos uva-ursi	396	400	370	379	276	240		
Linnaea borealis	261	307	391	399	395	394	232	252
Cassiope mertensiana				1				
Phyllodoce empetriformis			7	13				
Vaccinium caespitosum			382	372	336	330		
Vaccinium membranaceum					3			
Vaccinium myrtillus			5	62			208	160
Vaccinium scoparium			67		5	12	400	400
Vaccinium vitis-idaea			96	158				
Juniperus horizontalis		11	3	15				
FORBS								
Fragaria virginiana	389	387	375	373	41	46	1	1
Geum triflorum	1							
Potentilla fruticosa	1							
Rubus pubescens					1			
Chimaphila umbellata			87	96	31	39		
Orthilia secunda	74	60	262	288	230	236	96	77
Pyrola chlorantha	265	116	368	305	216	102	3	1
Cornus canadensis			120	136	342	373	96	111
Achillea millefolium	346	335	71	20	35	33		
Agoseris spp.			33	9		1		
Antennaria howellii	240	191	272	126				
Antennaria rosea	37	33	129	17	1			
Arnica cordifolia			74	57	141	138	363	358
Aster ciliolatus	2		60	51	17	15		2
Aster conspicuus			103	95	177	178		
Hieracium cynoglossoides	2		16					
Senecio streptanthifolius	193	221	94	1				
Solidago spp.	286	261	231	101	32	24		
Taraxacum officinale		1						
Castilleja miniata		1	44	35				
Melampyrum lineare			389	381				
Stellaria longipes	2							
Geocaulon lividum			1	11	44	89		
Viola adunca	164	170			2	2		

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Table 3-4. Continued.

SPECIES	**ATHABASCA**		**SUNWAPTA**		**WHIRLPOOL**		**HECTOR**	
	1967	**1989**	**1967**	**1989**	**1967**	**1989**	**1967**	**1989**
Campanula rotundifolia	73	28			57	18		
Epilobium angustifolium			37	29	34	31	197	116
Gentianella amarella	141	60	194	33				
Gentianella propinqua				1				
Lathyrus ochroleucus					15	17		
Vicia americana		3						
Trifolium repens		2	1		2	1		
Empetrum nigrum							34	26
Anemone multifida	5	5						
Anemone lithophila			1	1				
Zigadenus elegans						1		
Calypso bulbosa	36	62	17	2	85	24		
Corallorhiza trifida		8	29	10	7			
Goodyera oblongifolia			54	151	48	83	1	
Habenaria obtusata			7	18	1			
Habenaria orbiculata						1		
Habenaria unalascensis			1	10				
Habenaria viridis		9						
Listera cordata			3	1	5		3	
PTERIDOPHYTES								
Lycopodium annotinum					1	2	2	3
Lycopodium complanatum			6	39		14		1
GRAMINOIDS								
Bromus inermis	3							
Calamagrostis purpurescens	86	38						
Elymus innovatus	394	399	399	399	400	398	2	2
Festuca saximontana	125	59						
Festuca scabrella			1					
Poa spp.			1					
Trisetum spicatum			29		1	1		
Carex sp.	234	35	4				201	24

Table 3-5. Vascular understorey species richness, total cover, and diversity in 1967 and 1989 at the four permanent reference plots as measured using the Simpson and Shannon-Weaver indices. Total percentages for 1989 based on unconverted integer data are included in brackets (see Methods).

SITE	YEAR	SPECIES RICHNESS	TOTAL COVER (%)	SIMPSON DOMINANCE (C)	INDEX OF EQUITABILITY ($E=D/D_{max}$)	SHANNON WEAVER INDEX (H')
ATHABASCA	1967	32	11.90	0.536	0.479	1.240
	1989	32	56.39 (52.47)	0.330	0.691	1.652
SUNWAPTA	1967	50	14.00	0.463	0.548	1.487
	1989	47	29.31 (29.46)	0.177	0.841	2.102
WHIRLPOOL	1967	41	4.51	0.138	0.883	2.299
	1989	39	25.95 (25.17)	0.142	0.881	2.253
HECTOR	1967	24	38.65	0.686	0.328	0.733
	1989	24	32.38 (29.81)	0.813	0.195	0.731

Table 3-6. Ocular estimates of understorey moss and lichen species cover. Values indicate mean percentage cover based on 400 quadrat ocular estimates. Note that moss and lichen cover estimates were not broken down to individual species at Athabasca in 1967. "+" indicates , 0.01 but > 0 %.

SPECIES	ATHABASCA		SUNWAPTA		WHIRLPOOL		HECTOR	
	1967	1989	1967	1989	1967	1989	1967	1989
Dicranum polysetum		0.34	0.12	0.12	0.33	0.59	0.15	+
Dicranum undulatum		0.07		0.07				0.45
Hylocomium splendens		2.49	0.02	0.79	23.93	38.41	0.03	0.27
Pleurozium schreberi		7.39	4.94	34.41	12.00	12.66	5.96	36.44
Polytrichum juniperum		0.04	0.09	0.04		0.01	0.11	0.04
Ptilium crista-castrensis		0.19	0.32	0.15	0.40	0.08	0.23	
TOTAL MOSSES	**6.46**	**10.42**	**5.37**	**36.57**	**36.41**	**52.61**	**6.32**	**37.42**
Cladina spp.		0.10		0.30		0.23		0.01
Cladonia spp.		0.14	0.33	0.30		0.04	1.26	0.21
Peltigera spp.		5.03	0.71	0.78	0.77	3.15	0.70	0.83
Stereocaulon spp.		0.70	0.08	0.06		0.01	0.09	0.02
TOTAL LICHENS	**2.90**	**6.47**	**1.12**	**1.45**	**0.77**	**3.65**	**2.05**	**1.06**

from 1967 and was greatest at Sunwapta, followed by Whirlpool and Athabasca, and was lowest at Hector (Table 3-5). Vascular species dominance concentration (using Simpson's C index; see Methods), was greatest at the Hector site and also high at the Athabasca site, whereas the Sunwapta and Whirlpool sites had lower C values, indicating greater species evenness or equitability (Table 3-5). Between 1967 and 1989 species dominance increased at Hector and Sunwapta, decreased at Athabasca, and remained fairly stable at Whirlpool. Vascular species diversity of the understorey community (using the Shannon-Wiener H′ index) was greatest at the Whirlpool site and lowest at the Hector site (Table 3-5). It increased over the 22-year interval at Sunwapta, and to a lesser degree, at Athabasca, and remained stable at Whirlpool and Hector.

Moss and lichen species cover estimates are included in a separate table (Table 3-6) because, unlike Tables 3-3 and 3-4 which include all vascular species found, it only includes the major bryophyte and lichen species present in the four reference stands.

Moss cover increased in all four reference stands and by six-fold in both Sunwapta and Hector. In the latter two stands, increases in *Pleurozium schreberi*, the dominant moss species, accounted for almost all of this increase in total moss cover. Lichen cover increased greatly at Athabasca and Whirlpool but declined at Hector (Table 3-6).

3.3.2.1 Athabasca

The understorey of this xeric site was open with a poorly developed shrub stratum. *Shepherdia canadensis* was the dominant shrub species although there were also occasional dense and spreading patches of *Juniperus communis*. *Arctostaphylos uva-ursi* had the highest cover of all understorey species and it dominated the dwarf shrub stratum (Table 3-3). All forb species had low or very low cover but those with high frequencies included *Fragaria virginiana*, *Solidago* species, *Antennaria howellii*, *Achillea millefolium*, and *Senecio streptanthifolius* (Table 3-4). The graminoid growth-form was relatively poorly developed in 1967 and was dominated by *Carex* species, but by 1989 *Carex* cover and frequency had declined while a nine-fold increase in *Elymus innovatus* cover made this grass species the dominant graminoid (Tables 3-3 and 3-4). Bryoid cover was sparse over most of the site. However, moss cover was relatively high on an old river island that runs in a northwest to southeast direction through the site.

Vascular understorey species richness did not change between 1967 and 1989 but total understorey cover increased almost five-fold during that interval (Table 3-5). A large part of this dramatic increase in total vascular understorey cover was caused by a ten-fold increase in *Shepherdia canadensis* cover in the shrub stratum, and a three-fold increase in *Arctostaphylos uva-ursi* cover and a seven-fold increase in *Linnaea borealis* cover in the dwarf shrub stratum (Table 3-3). While the frequency of *E. innovatus* was close to 100 % in both study years, its cover increased from 0.2 % to 8.8 % (Tables 3-3 and 3-4). Other significant changes between 1967 and 1989 include: decreased dominance and increased diversity (Table 3-5); large increases in the covers of *Juniperus communis* (8-fold) and *Rosa acicularis* (21-fold) (Table 3-3); declines in the frequencies of *Pyrola chlorantha*, *Gentianella amarella*, *Campanula rotundifolia*, *Festuca saximontana*, and *Calamagrostis purpurascens*; and an increase in the frequencies of *J. communis* and *Calypso bulbosa* (Table 3-4).

3.3.2.2 Sunwapta

The shrub stratum at Sunwapta was better developed and had greater species richness than at Athabasca. *Shepherdia canadensis* was again the dominant shrub (Table 3-3) and *Juniperus communis* and *Rosa acicularis* were also common (Table 3-3).

The Sunwapta dwarf shrub stratum was not as well developed as it was at Athabasca but it was richer in species; *Linnaea borealis*, *Arctostaphylos uva-ursi*, *Vaccinium caespitosum*, and *V. vitis-idaea* were its principal components (Table 3-3).

Forb species richness was the highest of the four reference stands with no one species dominating. Forbs with the highest frequency were *Melampyrum lineare*, *Fragaria virginiana*, and *Pyrola chlorantha* (Table 3-4). *Melampyrum lineare*, *Castilleja miniata*, and *Aster ciliolatus* were all relatively common at Sunwapta but absent or rare in the other reference stands.

Species richness and cover of graminoid species were lower in Sunwapta than Athabasca; *Elymus innovatus* was again the dominant. The dominant bryoid species was *Pleurozium schreberi*.

There was a slight decrease in total understorey vascular species richness at Sunwapta, but cover of these species doubled between 1967 and 1989. The species contributing to this increase in cover were *Juniperus communis*, *Arctostaphylos uva-ursi*, *Linnaea borealis*, *Vaccinium caespitosum*, *Elymus innovatus*, and *Fragaria virginiana* (Table 3-3). As at Athabasca, the frequency of *E. innovatus* was close to 100 % in both study years despite the large differences in cover (Table 3-3 and 3-4). *Shepherdia canadensis*, the dominant vascular species in terms of cover, did not increase appreciably over the interval.

Large declines in the frequency of common species with low covers were seen for *Solidago* species, *Achillea millefolium*, *Antennaria howellii*, *A. rosea*, *Senecio streptanthifolius* (all Composites), and *Gentianella amarella* (an annual). Large increases in frequency were seen for *Vaccinium vitis-idaea* and *Goodyera oblongifolia* (Table 3-4).

3.3.2.3 Whirlpool

The understorey at Whirlpool was dominated by feather-mosses, in particular by *Hylocomium splendens* which was not found in abundance at any of the other three reference stands (Table 3-6). The cover of vascular species (4.5%) was very low in comparison to mosses (36.4%) in 1967, and despite a large increase by 1989 (to 25%), vascular plant cover was still the lowest of the four stands (Tables 3-5 and 3-6). Species richness and measures of dominance and diversity changed but little between the two study years (Table 3-5).

The shrub stratum was poorly developed in 1967 with the dominant species, *Shepherdia canadensis*, *Juniperus communis*, and *Rosa acicularis* all having < 1% covers (Table 3-3). The cover of these three species increased greatly over the 22 year interval, but by 1989 shrub cover was still very much lower than it was at the other stands.

The dwarf shrub stratum was similar in structure to that seen in the Sunwapta site. As at Sunwapta, *Linnaea borealis*, *Arctostaphylos uva-ursi* and *Vaccinium caespitosum* had the highest cover in this relatively poorly developed stratum (Table 3-2). The cover of these species also increased greatly (3 to 5-fold) between 1967 and 1989.

The forb stratum at Whirlpool was dominated and characterized by *Cornus* *canadensis* in terms of both cover and frequency (Tables 3-3 and 3-4). Other common forb species at Whirlpool were *Orthilia secunda*, *Pyrola chlorantha*, *Aster conspicuus*, and *Arnica cordifolia* (Table 3-4). Changes in the forb stratum between 1967 and 1989 included large declines in the frequency of *P. chlorantha*, *Calypso bulbosa*, and *Campanula rotundifolia*, and frequency increases in *Geocaulon lividum* and *Goodyera oblongifolia* (Table 3-4).

Elymus innovatus and *Trisetum spicatum* were the only two graminoids found at Whirlpool, and only a single occurrence of the latter species was found. *E. innovatus* had close to 100% frequency in both study years but its cover increased from rare in 1967 to above 3% in 1989 (Tables 3-3 and 3-4).

3.3.2.4 Hector

The high-elevation Hector site was characterized by its fully developed shrub stratum of *Menziesia ferruginea*. This species dominated the understorey of the stand and created a closed shrub canopy not seen at the other three reference stands. The closed shrub canopy of *Menziesia ferruginea* also contained some *Shepherdia canadensis*. Both species were lower in cover, but not in frequency, in 1989 than in 1967 (Tables 3-3 and 3-4). However, the reduction in cover for *M. ferruginea* may be partially accounted for by differences in observer cover estimates (Table 3-1).

Vaccinium scoparium, *Linnaea borealis*, and *Vaccinium myrtillus* were the only dwarf shrub species found at Hector (Table 3-3). The forb stratum was poorly developed and depauperate. Its most common species was *Arnica cordifolia*; others with high frequency were *Epilobium angustifolium*, *Cornus canadensis*, and *Orthilia secunda* (Table 3-4). Graminoids were virtually absent at the site. Sedges (*Carex* sp.) had very low cover in 1967 but were found in half the quadrats; in 1989, however, their frequency was only 6%.

The bryoid stratum was dominated by *Pleurozium schreberi*. As at Sunwapta, the cover of this moss was 6-fold higher in 1989 than 1967. However, the cover of lichen species changed little over the same interval (Table 3-6).

Species richness and species diversity were lowest and species dominance highest at this site and changed very little between 1967 and 1989 (Table 3-5).

3.3.3 Vascular Species Structure Curves

The two species structure curves derived from the 1967 and 1989 surveys at each of the four permanent reference stands are compressed together for comparative purposes in Figures 3-1 to 3-4.

3.3.3.1 Athabasca

In 1967 the species structure curve can be divided into three rather indistinct segments of species sequences (Figure 3-1). The first segment is steep and consists of 6 species, beginning with the dominant one, *Arctostaphylos uva-ursi* (8.6% cover), and ending with *Elymus innovatus* (0.20%). The second is more gently sloping and consists of 11 species, starting with *Rosa acicularis* (0.13%), and ending with *Orthilia secunda* (0.035%). The final segment is discontinuously steep and consists of 15 species, beginning with *Calamagrostis purpurascens* (0.028%), and ending with *Geum triflorum* (0.00025%). The top 5 species in the 1967 species dominance hierarchy are ARUV > LIBO > SHCA > CAREX > JUCO.

In 1989 the species structure curve can be divided into only two, but more distinct, species sequences. The first sequence is moderately steep and consists of 7 species, beginning with *Arctostaphylos uva-ursi* (26.95%), and ending with *Fragaria virginiana* (1.78%). The second sequence is displaced far down the plot, is less steep although it becomes progressively steeper, and consists of the remaining 25 species, beginning with *Achillea millefolium* (0.1%) and ending with *Lonicera dioica* (0.00025%). The top 5 species in the 1989 species dominance hierarchy are ARUV > ELIN > SHCA > LIBO > ROAC.

Comparing the two curves, the top seven species in 1967, especially *Elymus innovatus*, all had substantially higher cover in 1989. As a result, their segment is widely disjunct from the lower segment. The latter includes at least 10 species which showed little or no change in cover between years. Whereas *A. uva-ursi* was super-dominant in

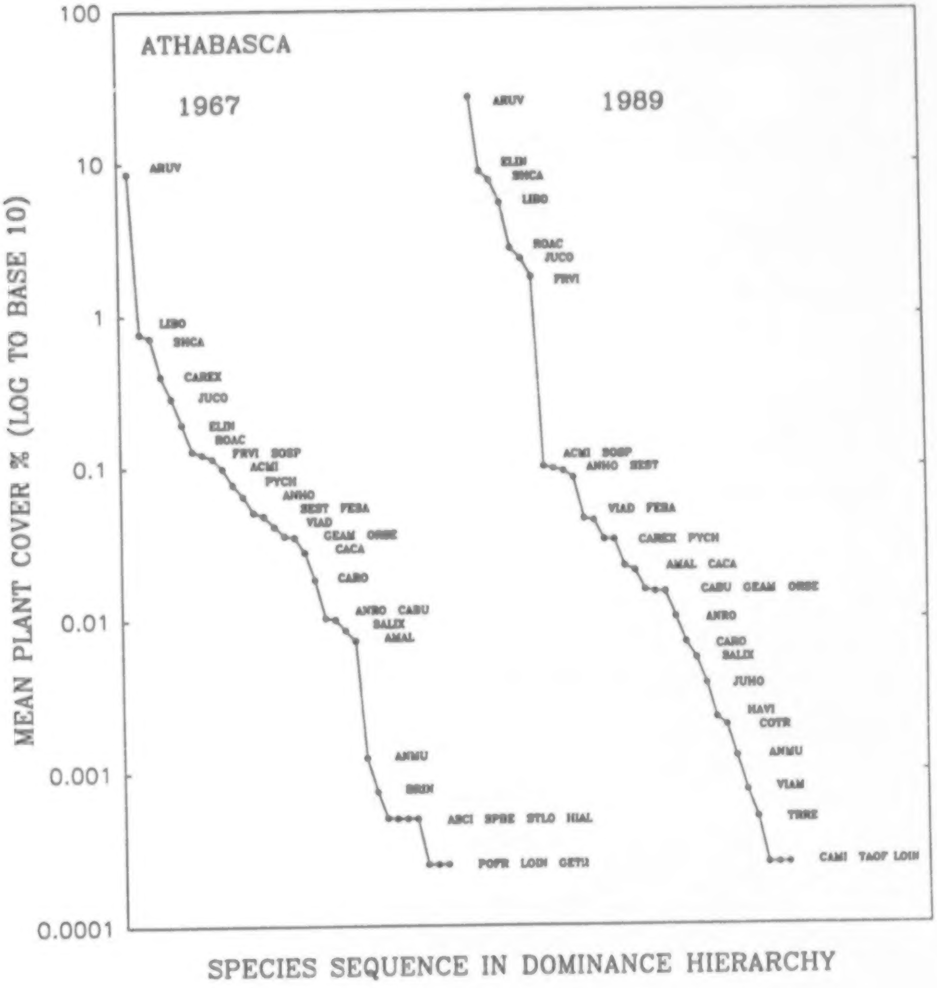


Figure 3-1. Species structure curve for the vascular plant understorey community at Athabasca in 1967 and 1989. Species codes are made up of the first two letters of the Latin genus and species names.

1967 and Simpson's dominance index was 0.536, three more species had > 5% cover in1989 and the index fell to 0.330 (Figure 3-1 and Table 3-5).

3.3.3.2 Sunwapta

The 1967 species structure curve is decidedly log-normal, with far more medium-cover than very high- or very low-cover species. It can be divided into two segments, although they are not very distinct (Figure 3-2). The first segment is steep and consists of only 3 species, *Shepherdia canadensis* (9.4%), *Juniperus communis* (1.13%), and *Linnaea borealis* (0.81%). The second segment contains the remaining 49 species and is less steep; it begins with *Arctostaphylos uva-ursi* (0.42%) and ends with *Trifolium repens* (0.00025%). The top 5 species in the 1967 species dominance hierarchy are SHCA > JUCO > LIBO > ARUV > ELIN.

The 1989 curve is even more S-shaped (log-normal) and can be divided into 3 quite distinct segments. The first segment is steep and consists of 12 species, beginning with *Shepherdia canadensis* (9.77%) and ending with *Orthilia secunda* (0.2%). The second segment is much less steep, consisting of 25 species, and begins with *Pyrola chlorantha* (0.08%) and ends with *Antennaria rosea* (0.004%). The third segment is steeper again and consists of the remaining 10 species, beginning with *Corallorhiza trifida* (0.003%) and ending with *Gentianella propinqua* (0.00025%). The top 5 species in the 1989 species dominance hierarchy are SHCA > JUCO > LIBO > ELIN > ARUV, only slightly different from 1967 in that *Elymus innovatus* and *Arctostaphylos uva-ursi* have exchanged places.

Comparing the two curves, the interpretation of Athabasca seems to apply here as well. Unlike *A. uva-ursi* at Athabasca, however, the super-dominant species at Sunwapta, *S. canadensis*, did not have higher cover in 1989, and the disjunction between upper and lower sections is not as large (Figure 3-2).

3.3.3.3 Whirlpool

The 1967 species structure curve at Whirlpool can be divided into 4 not very distinct segments (Figure 3-3). The first segment is moderately steep, consisting of 7

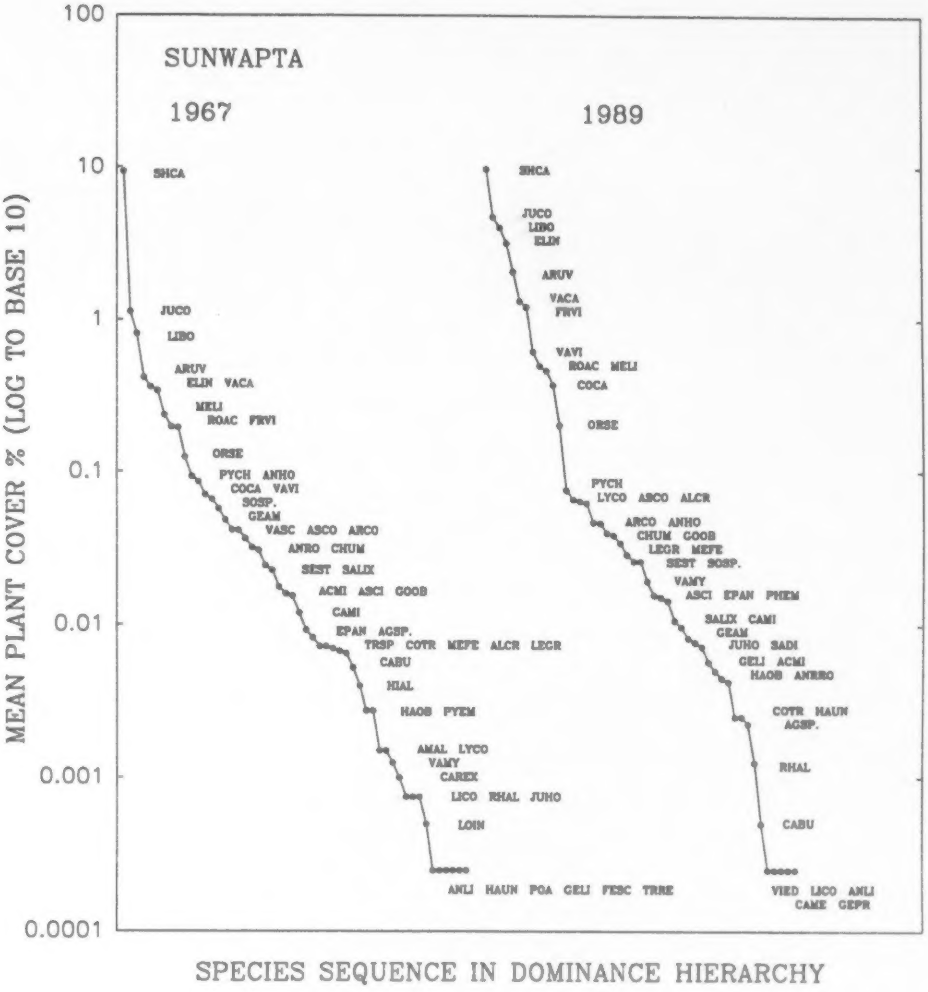


Figure 3-2. Species structure curves for the vascular plant understorey community at Sunwapta in 1967 and 1989. Species codes are made up of the first two letters of the Latin genus and species names.

species, beginning with *Linnaea borealis* (1.08%) and ending with *Elymus innovatus* (0.19%). The second segment is less steep, consists of only 5 species, and begins with *Rosa acicularis* (0.086%) and ends with *Pyrola chlorantha* (0.054%). The third segment has a similar slope but is displaced down the curve, consists of 16 species, beginning with *Calypso bulbosa* (0.023%) and ending with *Salix* sp. (0.004). The fourth sequence is discontinuous in slope and consists of the remaining rare 13 species, beginning with *Amelanchier alnifolia* (0.003%) and ending with *Rubus pubescens* (tied with 6 other species at 0.00025%). The top 5 species in the 1967 species dominance hierarchy are LIBO > COCA > VACA > JUCO > SHCA with sixth place *Arctostaphylos uva-ursi* almost tied with fifth place *Shepherdia canadensis*.

The 1989 species structure curve can also be divided into four segments, but these are more distinct than in 1967. The first segment is moderately steep, as in 1967, and consists of 7 species, beginning with *Shepherdia canadensis* (5.35%) and ending with *Juniperus communis* (1.88%). The second segment is steeper, although more discontinuous, than the first, consists of 9 species, beginning with *Arnica cordifolia* (0.58%) and ending with *Spiraea betulifolia* (0.052%). The third segment corresponds closely, in vertical position and species composition, to the third segment in 1967; has a moderate slope and consists of 15 species, beginning with *Pyrola chlorantha* (0.025%) and ending with *Campanula rotundifolia* (0.005%). The fourth segment begins with *Viola adunca* (0.0005%) and ends with 7 rare tied species at 0.00025%. The top 5 species in the 1989 species dominance hierarchy are SHCA > COCA > ELIN > LIBO > VACA.

Comparing the two curves, *Linnaea borealis* has fallen from first to fourth place, being replaced by *Shepherdia canadensis* which has advanced from fifth place. *Elymus innovatus* has entered the top five in third place, while *Juniperus communis* has fallen to seventh place. This indicates that despite its dynamic stability, as measured by species richness, dominance and diversity indices (Table 3-5), Whirlpool's understorey cover and species dominance hierarchy changed significantly. In addition, while only one of the top seven species in 1967 had cover > 1%, by 1989 each of these seven species had cover > 1%.

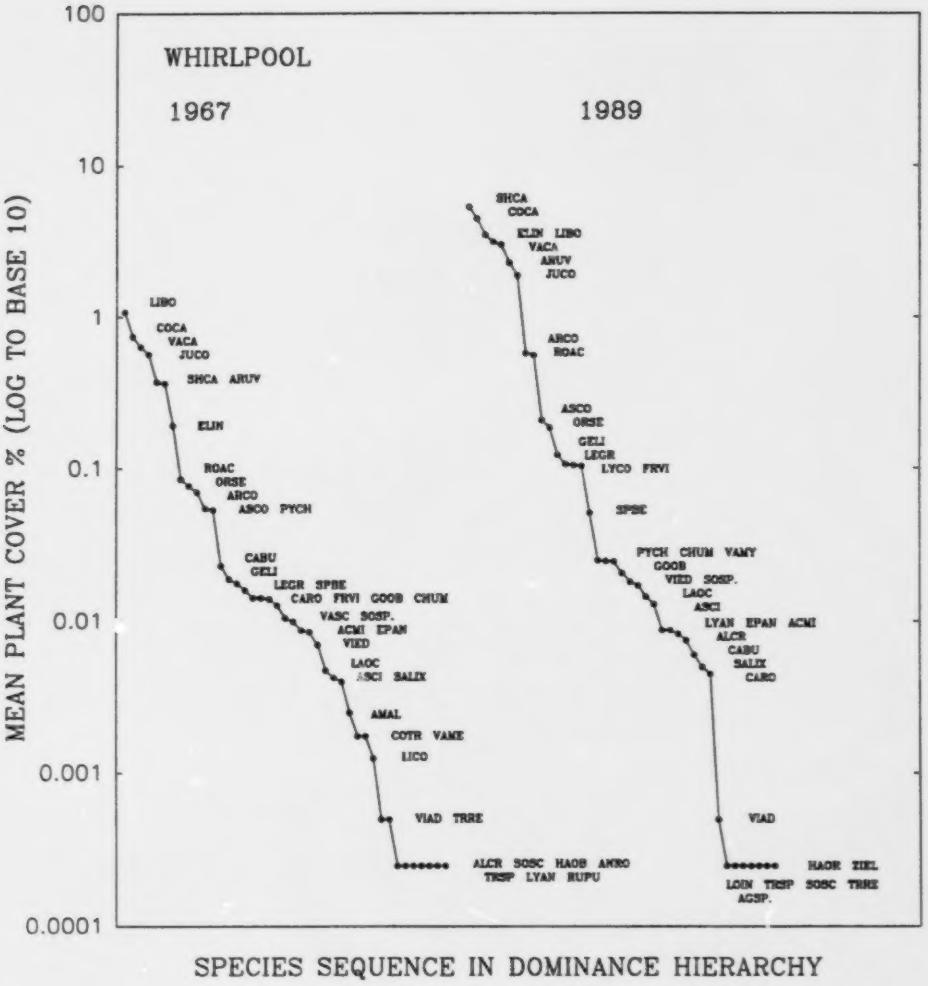


Figure 3-3. Species structure curves for the vascular plant understorey community at Whirlpool in 1967 and 1989. Species codes are made up of the first two letters of the Latin genus and species names.

3.3.3.4 Hector

The 1967 Hector species structure curve is much steeper and more linear (geometric) than those of the other stands. Hence, it is difficult to divide the 1967 curve into segments, but some general groupings can be seen (Figure 3-4). The super-dominant species, *Menziesia ferruginea* (31.77%), is far removed from other species but it can be placed in a group with *Shepherdia canadensis* (3.44%) and *Vaccinium scoparium* (1.86%). A second grouping consists of 14 species beginning with *Arnica cordifolia* (0.482%) and ending with *Spiraea betulifolia* (0.006%). The third grouping consists of the remaining 7 rare species, beginning with *Listera cordata* (0.002%) and ending with *Fragaria virginiana* (0.00025%). The top 5 species in the 1967 species dominance hierarchy are MEFE > SHCA > VASC > ARCO > VAMY.

It is not possible to discern any divisions or segments within the 1989 species structure curve for Hector. *Menziesia ferruginea* (26.7%) is again far removed from the rest of the species, which form a relatively continuous linear sequence from *Shepherdia canadensis* (2.3%) to *Pyrola chlorantha* (0.00025%). The top 5 species in the 1989 species dominance hierarchy are MEFE > SHCA > VASC > ARCO > LIBO, which is quite similar to 1967 except that *Linnaea borealis* has replaced *Vaccinium myrtillus* in fifth place.

Comparing the very similar 1967 and 1989 curves, it appears that the latter is even more linear, i.e., with more equally spaced species cover estimates, than the former. Their species dominance hierarchies are remarkably similar from top to bottom. Only a few species were notably more abundant in 1989 (*Cornus canadensis*) or 1967 (e.g., *V. myrtillus*, *Carex* sp.).

3.3.4 Understorey Species Distributions and Correlations

3.3.4.1 Athabasca

In both 1967 and 1989 the distributions of understorey species presence and cover were visibly affected by an old river island, on which the density of *Pinus contorta* stems was very high, surrounded by areas of coarse gravelly soils where the pine density was

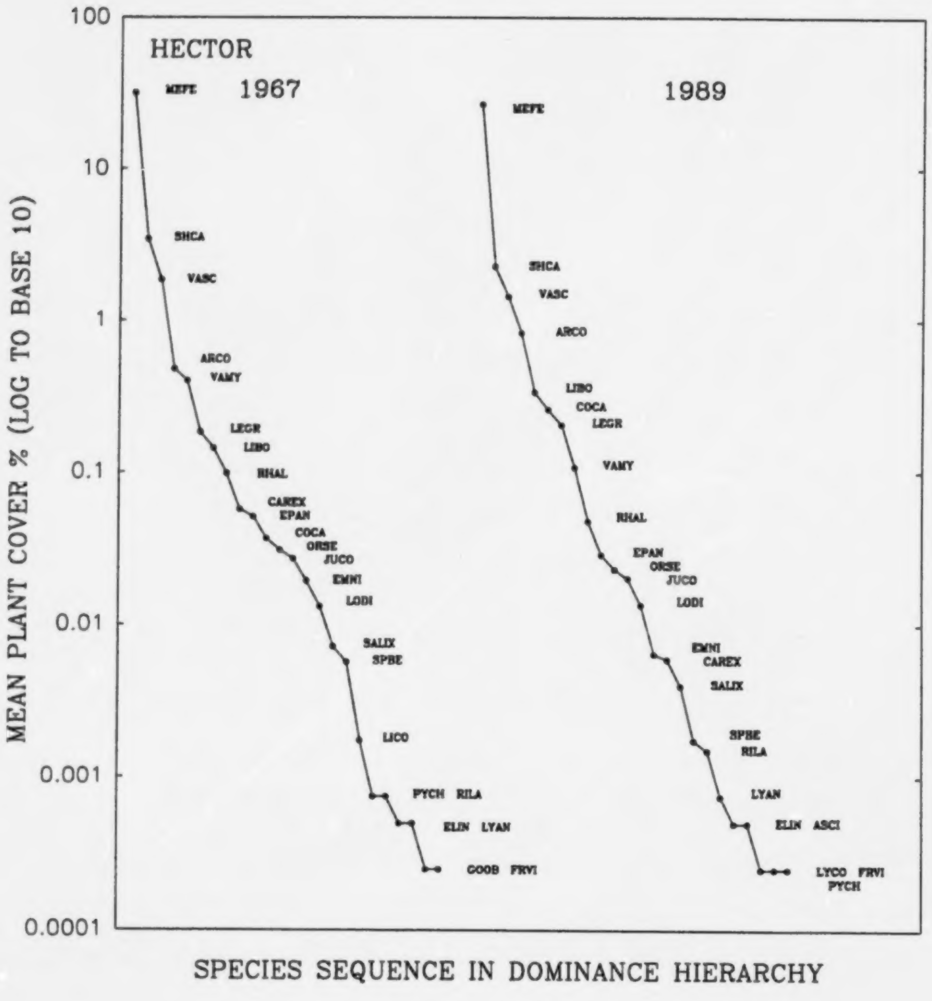


Figure 3-4. Species structure curves for the vascular plant understorey community at Hector in 1967 and 1989. Species codes are made up of the first two letters of the Latin genus and species names.

Table 3-7. Spearman's rank correlation coefficients for understorey species in 1967 at Athabasca. Only significant (p <= 0.05) correlations with absolute values equal to or greater than 0.20 are shown. Four-letter codes represent the binomial species names in which the first two letters of the genus and species names are combined. Exceptions to this are SALX = *Salix* spp., CARX = *Carex* spp., MOSS = moss species, LICH = Lichen spp., and PICOT = *Pinus contorta* trees.

	SHCA	AMAL	SALX	ARUV	LIBO	FRVI	ROAC	ORSE	PYCH	ACMI	ANHO	ANRO	SEST	SOSP	VIAD	CARO	GEAM	CABU	CAPU	ELIN	FESA	CARX	MOSS	LICH	PICOT
SHCA	1	.	.	.	.	.	.	+.21	.	.	.	.	-.23	-.22	.	.	.	.	.	.	.	.	+.29	+.23	+.38
AMAL	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SALX	.	.	1	-.26	.	.	.	+.34	.	-.25	.	.	.	-.25	.	.	.	.	.	.	.	.	+.31	.	.
ARUV	.	.	-.26	1	.	.	.	-.22	.	+.23	.	.	.	.	.	.	.	.	.	.	.	.	-.47	-.26	.
LIBO	.	.	.	.	1	.	.	.	.	.	.	-.21	.	.	.	.	.	.	.	.	.	.	.	.	.
FRVI	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ROAC	.	.	.	.	.	.	1	-.23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ORSE	+.21	.	+.34	-.22	.	.	-.23	1	+.25	-.23	.	.	-.25	-.34	-.20	.	.	.	.	.	.	.	+.31	.	+.39
PYCH	.	.	.	.	.	.	.	+.25	1	.	.	.	-.22	-.22	.	.	.	.	-.20	+.21	-.23	.	+.24	.	+.34
ACMI	.	.	-.25	+.23	.	.	.	-.23	.	1	.	.	.	+.26	.	.	.	.	.	.	.	.	-.28	-.20	-.29
ANHO	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ANRO	.	.	.	.	-.21	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
SEST	-.23	.	.	.	.	.	.	-.25	-.22	.	.	.	1	+.29	+.20	.	.	.	.	.	+.24	.	-.22	-.20	-.38
SOSP	-.22	.	-.25	.	.	.	.	-.34	-.22	+.26	.	.	+.29	1	+.83	+.20	.	.	.	.	.	.	-.32	.	-.43
VIAD	.	.	.	.	.	.	.	-.20	.	.	.	.	+.20	+.83	1	.	.	.	.	.	.	.	-.21	.	-.31
CARO	.	.	.	.	.	.	.	.	.	.	.	.	.	+.20	.	1	+.20	.	.	.	.	.	.	.	.
GEAM	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.20	1	.	.	.	.	.	.	.	.
CABU	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
CAPU	.	.	.	.	.	.	.	.	-.20	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
ELIN	.	.	.	.	.	.	.	.	+.21	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
FESA	.	.	.	.	.	.	.	.	-.23	.	.	.	+.24	.	.	.	.	.	.	.	1	.	.	.	.
CARX	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	-.20
MOSS	+.29	.	+.31	-.47	.	.	.	+.31	+.24	-.28	.	.	-.22	-.32	-.21	.	.	.	.	.	.	.	1	+.54	+.44
LICH	+.23	.	.	-.26	.	.	.	.	.	-.20	.	.	-.20	.	.	.	.	.	.	.	.	.	+.54	1	+.33
PICOT	+.38	.	.	.	.	.	.	+.40	+.34	-.29	.	.	-.38	-.43	-.31	.	.	.	.	.	.	-.20	+.44	+.33	1

Table 3-8. Spearman's rank correlation coefficients for understorey species in 1989 at Athabasca. Only significant (p <= 0.05) correlations with absolute values equal to or greater than 0.20 are shown. Four-letter codes represent the binomial species names in which the first two letters of the genus and species names are combined. Exceptions to this are SALX = *Salix* spp., CARX = *Carex* species, MOSS = moss species, LICH = Lichen spp., and PICOT = *Pinus contorta* trees.

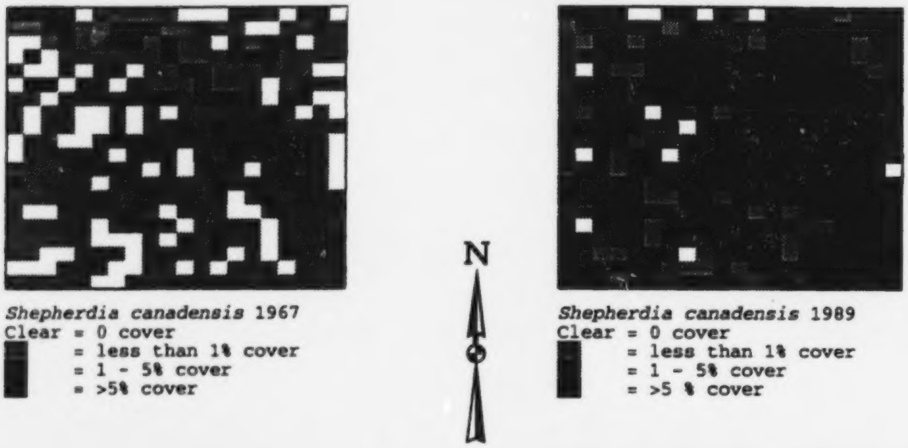
	SHCA	AMAL	SALX	ARUV	LIBO	FRVI	ROAC	ORSE	PYCH	ACMI	ANHO	ANRO	SEST	SOSP	VIAD	CARO	GEAM	CABU	CAPU	ELIN	FESA	CARX	MOSS	LICH	PICOT
SHCA	1	.	.	.	.	.	.	.	+.25	-.23	-.20	.	-.24	.	.	.	.	.	.	.	.	.	+.31	.	+.30
AMAL	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.20	.	.	.	.	.	.
SALX	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.25	.	.
ARUV	.	.	.	1	.	+.20	+.38	.	-.25	.	.	.	.	.	.	.	.	.	.	+.28	.	.	-.28	.	.
LIBO	.	.	.	.	1	.	+.27	.	.	.	.	.	.	-.24	.	.	.	.	.	.	.	.	+.34	.	+.20
FRVI	.	.	.	+.20	.	1	.	.	.	+.24	.	.	.	.	.	.	.	.	.	+.25	.	.	.	.	.
ROAC	.	.	.	+.38	+.27	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.23	.
ORSE	.	.	.	.	.	.	.	1	+.20	.	.	.	.	.	.	.	.	.	.	.	.	.	+.30	.	.
PYCH	+.25	.	.	-.25	.	.	.	+.20	1	.	.	.	-.30	.	.	.	.	.	.	.	.	.	+.37	.	+.28
ACMI	-.23	.	.	.	.	+.24	.	.	.	1	.	.	+.27	.	.	.	.	.	.	+.24	.	.	-.22	.	-.21
ANHO	-.20	.	.	.	.	.	.	.	.	.	1	+.20	+.29	+.21	.	.	.	.	.	.	.	+.21	-.26	.	-.27
ANRO	.	.	.	.	.	.	.	.	.	.	+.20	1	.	+.21	.	.	.	.	.	.	.	.	-.21	.	.
SEST	-.24	.	.	.	.	.	.	.	-.30	+.27	+.29	.	1	.	+.32	.	+.23	.	.	.	.	.	-.29	.	-.35
SOSP	.	.	.	.	-.24	.	.	.	.	.	+.21	+.21	.	1	.	.	.	.	.	+.23	.	.	-.31	.	-.23
VIAD	.	.	.	.	.	.	.	.	.	.	.	.	+.32	.	1	.	.	.	.	+.26	.	.	.	.	-.21
CARO	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	-.21
GEAM	.	.	.	.	.	.	.	.	.	.	.	.	+.23	.	.	.	1	.	.	.	.	.	.	.	-.20
CABU	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	+.21	.	+.21
CAPU	.	+.20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+.27	.	.	.	.
ELIN	.	.	.	+.28	.	+.25	.	.	.	+.24	.	.	.	+.23	+.26	.	.	.	.	1	.	.	-.23	.	-.22
FESA	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.27	.	1	.	.	.	-.20
CARX	.	.	.	.	.	.	.	.	.	.	+.21	.	.	.	.	.	.	.	.	.	.	1	.	.	.
MOSS	+.31	.	+.25	-.28	+.34	.	.	+.30	+.37	-.22	-.26	-.21	-.29	-.31	.	.	.	+.21	.	-.23	.	.	1	.	+.39
LICH	.	.	.	.	.	.	+.23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	-.20
PICOT	+.30	.	.	.	+.20	.	.	.	+.28	-.21	-.28	.	-.35	-.23	-.21	-.21	-.20	+.21	.	-.22	-.20	.	+.39	-.20	1

lower (see Figure 1-4 in Chapter 1 and Figure 2-12 in Chapter 2). In 1967 *Solidago* species, *Viola adunca* (Figure 3-6b), and *Senecio streptanthifolius* (Figure 3-5c) were positively correlated with each other (Table 3-7) but negatively correlated with the areas of dense pine. *Shepherdia canadensis* (Figure 3-5a), *Orthilia secunda* (Figure 3-6a), mosses (Figure 3-6c), and lichens (there was no species differentiation for bryoids at Athabasca in 1967) were positively correlated with each other and with the dense pine area on the sand dune (Table 3-7). Negative correlations in 1967 occurred between species associated with the dense pine area (e.g., *Orthilia secunda* and mosses), and species avoiding this area of the stand (e.g., *Arctostaphylos uva-ursi* (Figure 3-5b) and *Achillea millefolium*) (Table 3-7).

In 1989, differences in species abundance changed the correlation matrix only slightly, and the basic distribution pattern relating to the dense pine area on the sand dune remained (Table 3-8). Mosses, which were still concentrated under the dense pine, were positively correlated with *S. canadensis* (Figure 3-5a), *Linnaea borealis*, *O. secunda*, *Pyrola chlorantha*, and *Calypso bulbosa* (Table 3-8). The newly important *Elymus innovatus* had strong positive correlations with *A. uva-ursi*, *V. adunca*, and *Fragaria virginiana*. Also, *S. streptanthifolius* (see Figure 3-5) became positively correlated with *V. adunca*, *Antennaria howellii*, and *A. millefolium*; and *Rosa acicularis* became positively correlated with both *A. uva-ursi* and *L. borealis*. With the exceptions of *Rosa acicularis*, *L. borealis*, and *V. adunca*, these species were all negatively correlated with mosses and the dense pine on the sand dune.

3.3.4.2 Sunwapta

The tree canopy and topography at Sunwapta were more uniform than at Athabasca and were not as much of a factor in controlling the distribution of understorey species. However, the abundances of *Shepherdia canadensis* (Figure 3-7a), *Vaccinium* spp. (Figure 3-8b), *Cornus canadensis*, *Salix* spp. (Figure 3-8a) and *Pleurozium schreberi* (Figure 3-8c) were slightly higher in the east and south-east portion of the plot. The reverse pattern was true for *Rosa acicularis* (Figure 3-7b) and *Juniperus communis* (Figure 3-7c).

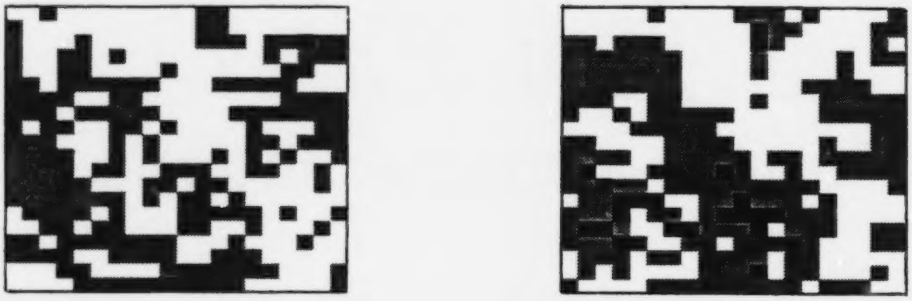


Shepherdia canadensis 1967
Clear = 0 cover
░ = less than 1% cover
▒ = 1 - 5% cover
■ = >5% cover

Shepherdia canadensis 1989
Clear = 0 cover
░ = less than 1% cover
▒ = 1 - 5% cover
■ = >5 % cover

Arctostaphylos uva-ursi 1967
Clear = 0 cover
░ = <5% cover
▒ = 5 - 15 % cover
■ = >15% cover

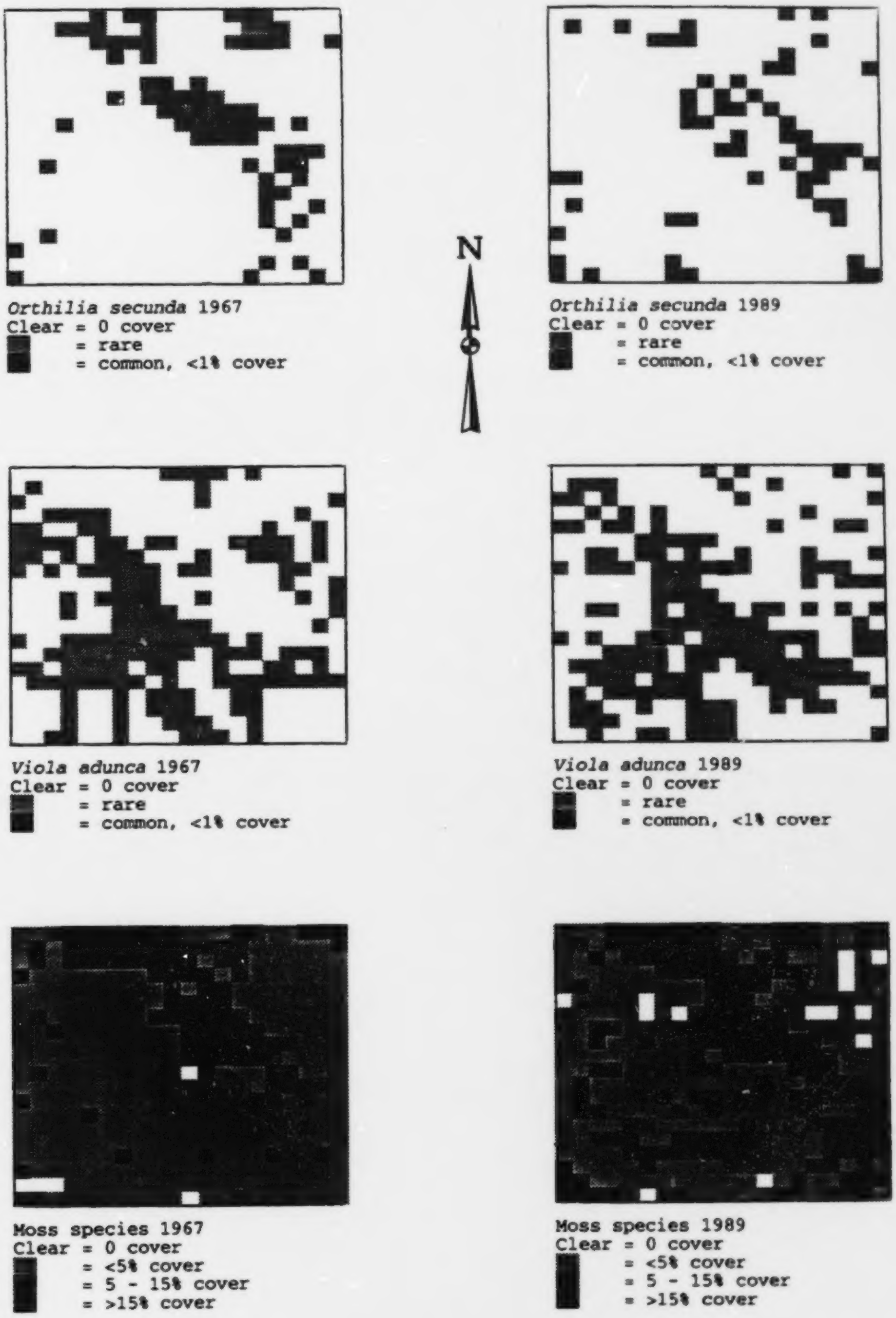
Arctostaphylos uva-ursi 1989
Clear = 0 cover
░ = <5% cover
▒ = 5 - 15% cover
■ = >15 % cover



Senecio streptanthifolius 1967
Clear = 0 cover
▒ = rare
■ = common, <1% cover

Senecio streptanthifolius 1989
Clear = 0 cover
▒ = rare
■ = common, <1% cover

Figure 3-5. Cover distribution maps of *Shepherdia canadensis*, *Arctostaphylos uva-ursi*, and *Senecio streptanthifolius* in 1967 and 1989 at the Athabasca permanent plot. See also 1967 maps in Hnatiuk (1969).



Orthilia secunda 1967
Clear = 0 cover
▨ = rare
■ = common, <1% cover

Orthilia secunda 1989
Clear = 0 cover
▨ = rare
■ = common, <1% cover

Viola adunca 1967
Clear = 0 cover
▨ = rare
■ = common, <1% cover

Viola adunca 1989
Clear = 0 cover
▨ = rare
■ = common, <1% cover

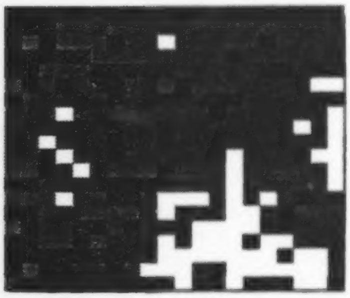
Moss species 1967
Clear = 0 cover
▨ = <5% cover
▩ = 5 - 15% cover
■ = >15% cover

Moss species 1989
Clear = 0 cover
▨ = <5% cover
▩ = 5 - 15% cover
■ = >15% cover

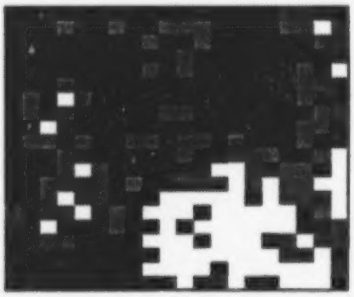
Figure 3-6. Cover distribution maps of *Orthilia secunda*, *Viola adunca*, and mosses in 1967 and 1989 at the Athabasca permanent plot.

Shepherdia canadensis 1967
Clear = 0 cover
▨ = <5% cover
▨ = 6 - 15% cover
■ = >15% cover

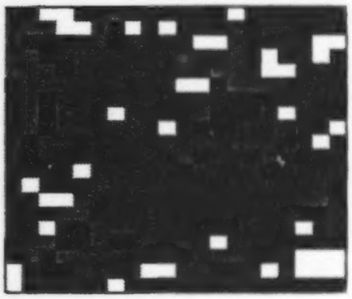
Shepherdia canadensis 1989
Clear = 0 cover
▨ = <5% cover
▨ = 6 - 15% cover
■ = >15% cover



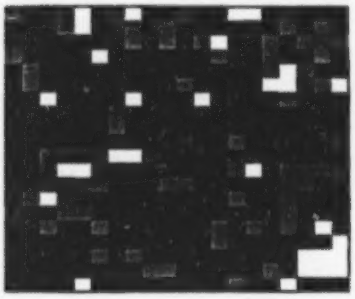
Rosa acicularis 1967
Clear = 0 cover
▨ = rare
▨ = common, <1% cover
■ = >1% cover



Rosa acicularis 1989
Clear = 0 cover
▨ = rare
▨ = common, <1% cover
■ = >1% cover



Juniperus communis 1967
Clear = 0 cover
▨ = <1% cover
▨ = 1 - 5% cover
■ = >5% cover



Juniperus communis 1989
Clear = 0 cover
▨ = <1% cover
▨ = 1 - 5% cover
■ = >5% cover

Figure 3-7. Cover distribution maps of *Shepherdia canadensis*, *Rosa acicularis*, and *Juniperus communis* in 1967 and 1989 at the Sunwapta permanent plot.

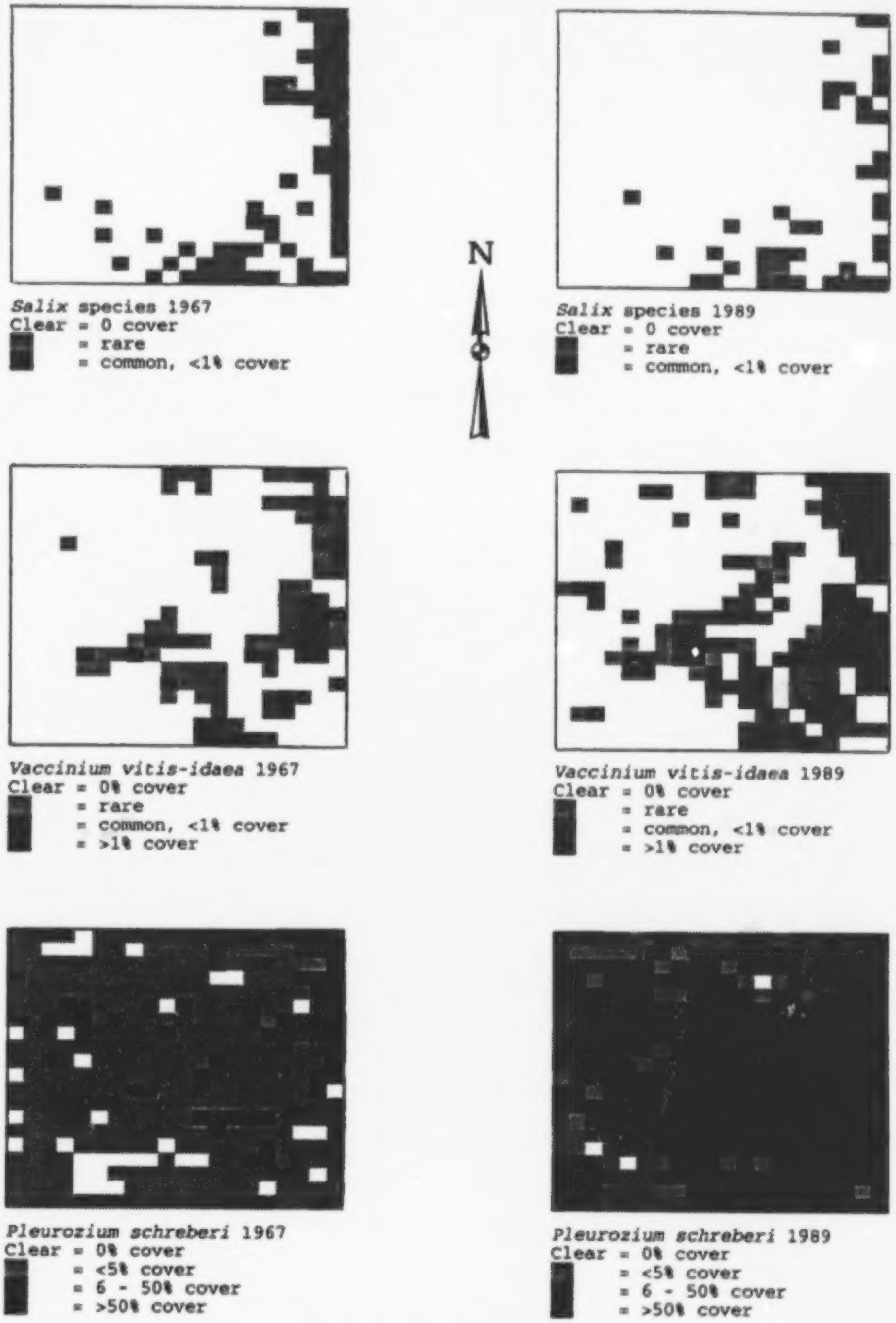

N
Salix species 1967
Clear = 0 cover
= rare
= common, <1% cover
Salix species 1989
Clear = 0 cover
= rare
= common, <1% cover
Vaccinium vitis-idaea 1967
Clear = 0% cover
= rare
= common, <1% cover
= >1% cover
Vaccinium vitis-idaea 1989
Clear = 0% cover
= rare
= common, <1% cover
= >1% cover
Pleurozium schreberi 1967
Clear = 0% cover
= <5% cover
= 6 - 50% cover
= >50% cover
Pleurozium schreberi 1989
Clear = 0% cover
= <5% cover
= 6 - 50% cover
= >50% cover

Figure 3-8. Cover distribution maps of *Salix* species, *Vaccinium vitis-idaea*, and *Pleurozium schreberi* in 1967 and 1989 at the Sunwapta permanent plot.

In 1967 strong positive correlations occurred between *Pleurozium schreberi* and the other moss species which included *Ptilium crista-castrensis*, *Hylocomium splendens*, and *Dicranum polysetum* (Table 3-9). *Pleurozium* was also positively correlated with the vascular species *Chimaphila umbellata*, *Fragaria virginiana*, *Salix* species, and the two important *Vaccinium* species present (*V. caespitosum* and *V. vitis-idaea*). However, it was negatively correlated with *Elymus innovatus*. *Salix* species, whose distribution was limited to the eastern portion of the reference stand, were positively correlated with *V. vitis-idaea*, *Fragaria virginiana*, *Arnica cordifolia*, and *Aster conspicuus*, but negatively correlated with *Rosa acicularis*. Other noteworthy positive correlations were seen between *Arctostaphylos uva-ursi* and *Linnaea borealis*, and between *Arnica cordifolia* and *Aster conspicuus*.

In 1989 there were fewer significant positive correlations but the general pattern remained the same. However, the number of negative correlations increased greatly (Table 3-10). *Vaccinium vitis-idaea* and *Hylocomium splendens* were concentrated in the east and southeastern portion of the stand and were negatively correlated with *Rosa acicularis*, which was mostly absent in the southeast. Other negative correlations in 1989 included *Melampyrum lineare* with *V. vitis-idaea* and *Aster conspicuus*; and *Juniperus communis* with *Elymus innovatus*.

3.3.4.3 Whirlpool

The Whirlpool stand was divided into an upper and lower terrace and this strongly affected the distribution and correlations of understorey species in the stand in both 1967 and 1989 (see Figure 1-4 in Chapter 1). In both study years *Shepherdia canadensis* (Figure 3-9a), *Arctostaphylos uva-ursi* (Figure 3-9b), *Aster conspicuus* (Figure 3-10a), *Dicranum polysetum*, and *Pleurozium schreberi* (Figure 3-10c) were found principally on the upper terrace, while *Cornus canadensis* (Figure 3-9c), *Arnica cordifolia*, and *Hylocomium splendens* (Figure 3-10b) had their areas of greatest cover on the lower terrace.

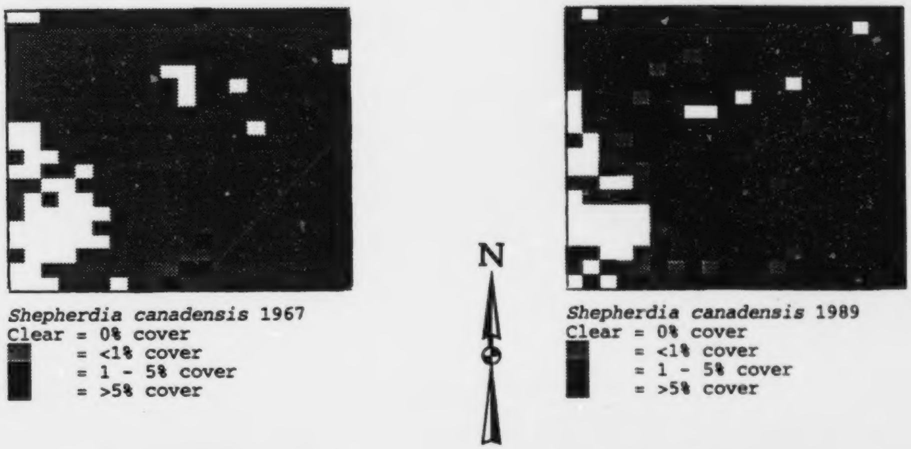
The correlation matrix for 1967 (Table 3-11) shows that *Hylocomium splendens*, the dominant feather moss in both years, was positively correlated with *Picea mariana*

Table 3-9. Spearman's rank correlation coefficients for understorey species in 1967 at Sunwapta. Only significant (p <= 0.05) correlations with absolute values equal to or greater than 0.20 are shown. Four-letter codes represent the binomial species names in which the first two letters of the genus and species names are combined. Exceptions to this are SALX = *Salix* spp., LICH = Lichen spp., and PICOR = *Pinus contorta* establishment.

	SHCA	JUCO	SALX	ARUV	VACA	VAVI	LIBO	FRVI	ROAC	CHUM	ORSE	COCA	ACMI	ANHO	ARCO	ASCI	ASCO	SOSP	MELI	ELIN	DIPO	HYSP	PLSC	PTCR	LICH	PICOR
SHCA	1	.	.	.	.	.	.	.	.	.	+.22	+.21	.	-.22	.	.	.	.	.	.	.	.	.	.	-.29	-.28
JUCO	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SALX	.	.	1	.	.	+.31	.	+.26	-.28	.	.	+.24	.	.	+.35	+.20	+.28	.	.	.	.	.	+.27	.	.	.
ARUV	.	.	.	1	.	.	+.33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
VACA	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.26	+.21	.	.
VAVI	.	.	+.31	.	.	1	.	.	.	+.24	.	.	.	.	+.22	.	.	.	.	.	.	.	+.24	.	.	.
LIBO	.	.	.	+.33	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FRVI	.	.	+.26	.	.	.	.	1	.	.	.	.	.	+.23	.	+.22	.	.	.	.	.	.	+.29	.	.	.
ROAC	.	.	-.28	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CHUM	.	.	.	.	.	+.24	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	+.31	.	.	.
ORSE	+.22	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+.22	+.22	.	.	.
COCA	+.21	.	+.24	.	.	.	.	.	.	.	.	1	.	.	+.29	.	+.27	.	.	.	.	.	.	.	.	.
ACMI	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	+.23	.	.	.	.	.	.	.	.
ANHO	-.22	.	.	.	.	.	.	+.23	.	.	.	.	.	1	.	.	.	+.24	.	.	.	.	.	.	.	+.24
ARCO	.	.	+.35	.	.	+.22	.	.	.	.	.	+.29	.	.	1	.	+.35	.	.	.	.	.	.	.	.	.
ASCI	.	.	+.20	.	.	.	.	+.22	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+.22	.	.	.
ASCO	.	.	+.28	.	.	.	.	.	.	.	.	+.27	.	.	+.35	.	1	.	.	.	.	.	.	.	.	.
SOSP	.	.	.	.	.	.	.	.	.	.	.	.	+.23	+.24	.	.	.	1	.	.	.	.	.	.	.	.
MELI	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
ELIN	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	-.20	.	.	.
DIPO	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+.33	+.3	+.25	+.23
HYSP	.	.	.	.	.	.	.	.	.	.	+.22	.	.	.	.	.	.	.	.	.	.	1	+.27	.	.	.
PLSC	.	.	+.27	.	+.26	+.24	.	+.29	.	+.31	+.22	.	.	.	.	+.22	.	.	.	-.22	+.33	+.27	1	+.5	.	+.31
PTCR	.	.	.	.	+.21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.3	.	+.5	1	.	+.26
LICH	-.29	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.25	.	.	.	1	.
PICOR	-.28	.	.	.	.	.	.	.	.	.	.	.	.	+.24	.	.	.	.	.	.	+.23	.	+.31	+.26	.	1

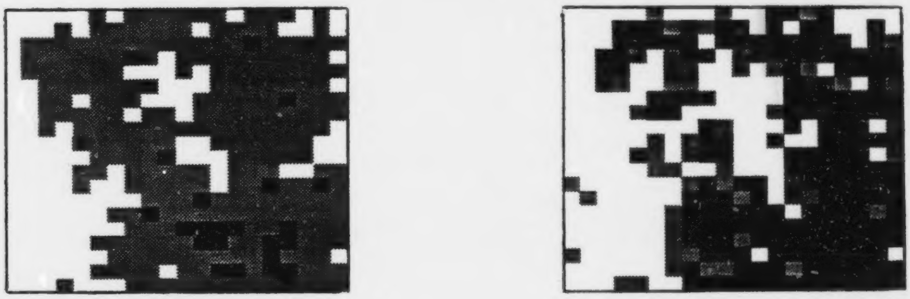
Table 3-10. Spearman's rank correlation coefficients for understorey species in 1989 at Sunwapta. Only significant (p <= 0.05) correlations with absolute values equal to or greater than 0.20 are shown. Four-letter codes represent the binomial species names in which the first two letters of the genus and species names are combined. Exceptions to this are SALX = *Salix* spp., LICH = Lichen spp., and PICOR = *Pinus contorta* establishment.

	SHCA	JUCO	SALX	ARUV	VACA	VAVI	LIBO	FRVI	ROAC	CHUM	ORSE	COCA	ACMI	ANHO	ARCO	ASCI	ASCO	SOSP	MELI	GOOB	ELIN	DIPO	HYSP	PLSC	PTCR	LICH	PINER
SHCA	1	.	.	.	.	.	.	.	.	.	.	.	.	-.30	.	.	.	.	.	.	.	.	.	.	+.22	-.30	-.21
JUCO	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-.38	.	.	.	.	.	.
SALX	.	.	1	.	.	+.21	.	.	-.26	.	.	.	.	.	+.23	.	.	.	.	.	.	.	.	.	.	.	.
ARUV	.	.	.	1	.	.	.	.	.	.	.	-.23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
VACA	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.33	.	.	.
VAVI	.	.	+.21	.	.	1	.	.	-.36	+.21	.	.	.	.	+.28	.	+.27	.	-.33	.	.	.	+.28	+.34	+.28	-.22	.
LIBO	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FRVI	.	.	.	.	.	.	.	1	.	.	.	.	.	+.26	.	.	.	.	.	.	.	.	.	.	.	.	.
ROAC	.	.	-.26	.	.	-.36	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	+.21	-.38	-.24	-.22	.	.
CHUM	.	.	.	.	.	+.21	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+.27	.	.	+.23
ORSE	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
COCA	.	.	.	-.23	.	.	.	.	.	.	.	1	.	.	+.26	.	+.25	.	-.20	.	.	.	.	.	.	-.26	.
ACMI	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ANHO	-.25	.	.	.	.	.	.	+.26	.	.	.	.	.	1	.	.	.	+.21	.	.	.	.	.	.	.	.	.
ARCO	.	.	+.23	.	.	+.28	.	.	.	.	.	+.26	.	.	1	.	+.32	.	-.20	.	.	.	.	.	.	.	.
ASCI	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+.20	.	.	.	.	.	.	.	.	.	.
ASCO	.	.	.	.	.	+.27	.	.	.	.	.	+.25	.	.	+.32	+.20	1	.	-.28	.	.	.	.	.	.	-.20	.
SOSP	.	.	.	.	.	.	.	.	.	.	.	.	.	+.21	.	.	.	1	.	.	.	.	.	-.21	.	.	.
MELI	.	.	.	.	.	-.33	.	.	.	.	.	-.20	.	.	-.20	.	-.28	.	1	.	.	+.24	.	-.24	-.25	+.37	.
ELIN	.	-.38	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
DIPO	.	.	.	.	.	.	.	.	+.21	.	.	.	.	.	.	.	.	.	+.24	.	.	1	-.23	-.23	-.27	+.28	.
HYSP	.	.	.	.	.	+.28	.	.	-.38	.	.	.	.	.	.	.	.	.	.	.	.	-.23	1	+.37	+.35	.	+.24
PLSC	.	.	.	.	+.33	+.34	.	.	-.24	+.27	.	.	.	.	.	.	.	-.21	-.24	.	.	-.23	+.37	1	+.33	-.21	+.37
PTCR	+.22	.	.	.	.	+.28	.	.	-.22	.	.	.	.	.	.	.	.	.	-.25	.	.	-.27	+.35	+.33	1	-.24	.
LICH	-.30	.	.	.	.	-.22	.	.	.	.	.	-.26	.	.	.	.	-.20	.	+.37	.	.	+.28	.	-.21	-.24	1	.
PICOR	-.21	.	.	.	.	.	.	.	.	+.23	.	.	.	.	.	.	.	.	.	.	.	.	+.24	+.37	.	.	1



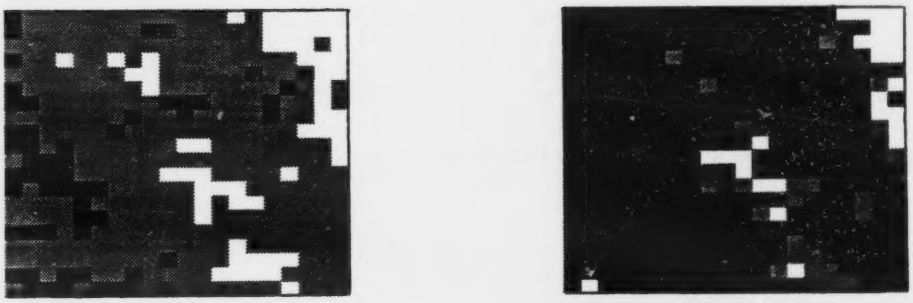
Shepherdia canadensis 1967
Clear = 0% cover
▒ = <1% cover
▓ = 1 - 5% cover
█ = >5% cover

Shepherdia canadensis 1989
Clear = 0% cover
▒ = <1% cover
▓ = 1 - 5% cover
█ = >5% cover



Arctostaphylos uva-ursi 1967
Clear = 0% cover
▒ = <1% cover
▓ = 1 - 5% cover
█ = >6% cover

Arctostaphylos uva-ursi 1989
Clear = 0% cover
▒ = <1% cover
▓ = 1 - 5% cover
█ = >6% cover



Cornus canadensis 1967
Clear = 0% cover
▒ = <1% cover
▓ = 1 - 5% cover
█ = >5% cover

Cornus canadesis 1989
Clear = 0% cover
▒ = <1% cover
▓ = 1 - 5% cover
█ = >5% cover

Figure 3-9. Cover distribution maps of *Shepherdia canadensis*, *Arctostaphylos uva-arsi*, and, *Cornus canadensis* in 1967 and 1989 at the Whirlpool permanent plot.

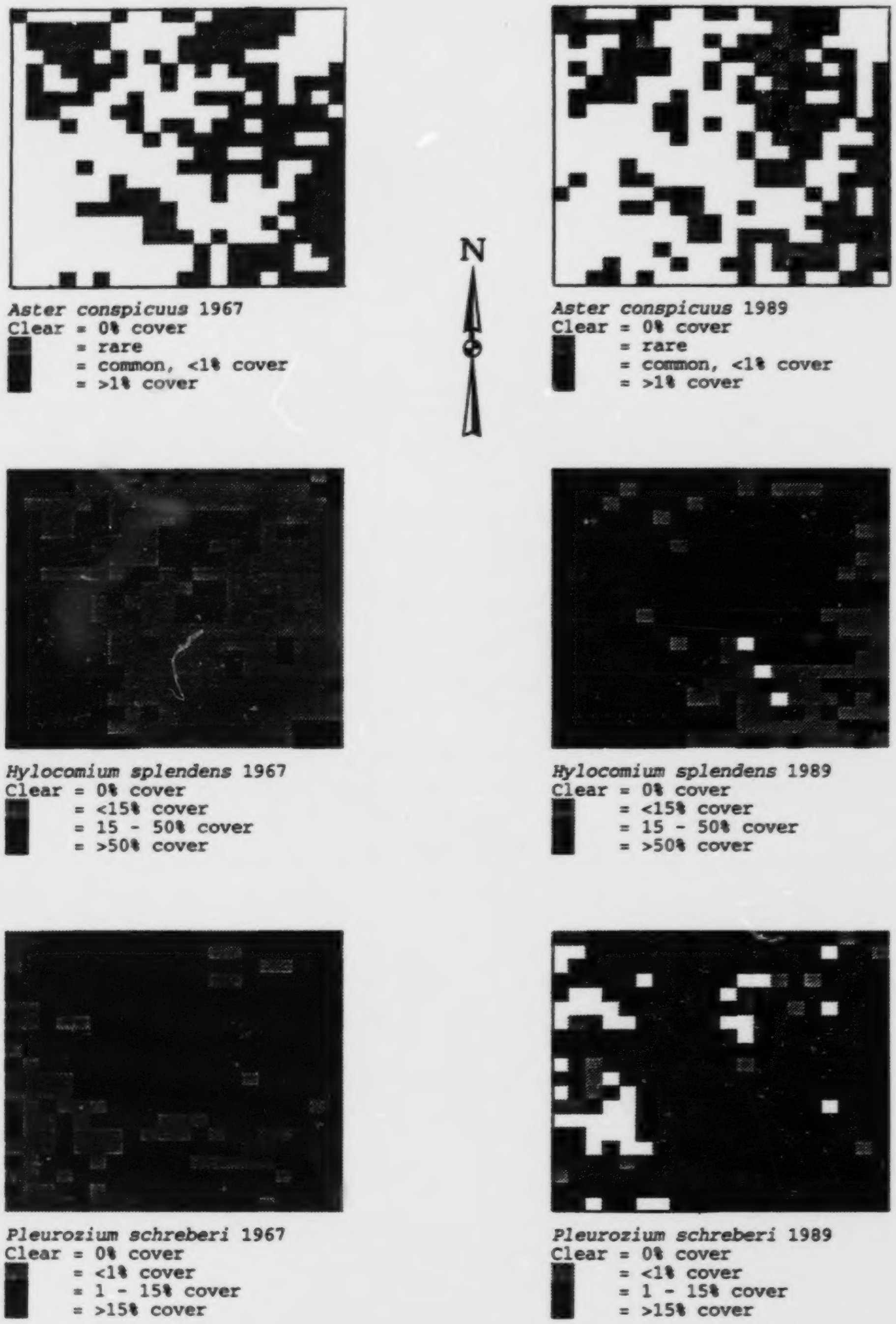

Aster conspicuus 1967
Clear = 0% cover
= rare
= common, <1% cover
= >1% cover
N
Aster conspicuus 1989
Clear = 0% cover
= rare
= common, <1% cover
= >1% cover
Hylocomium splendens 1967
Clear = 0% cover
= <15% cover
= 15 - 50% cover
= >50% cover
Hylocomium splendens 1989
Clear = 0% cover
= <15% cover
= 15 - 50% cover
= >50% cover
Pleurozium schreberi 1967
Clear = 0% cover
= <1% cover
= 1 - 15% cover
= >15% cover
Pleurozium schreberi 1989
Clear = 0% cover
= <1% cover
= 1 - 15% cover
= >15% cover

Figure 3-10. Cover distribution maps of *Aster conspicuus*, *Hylocomium splendens*, and *Pleurozium schreberi* in 1967 and 1989 at the Whirlpool permanent plot.

Table 3-11. Spearman's rank correlation coefficients for understorey species in 1967 at Whirlpool. Only significant (p <= 0.05) correlations with absolute values equal to or greater than 0.20 are shown. Four-letter codes represent the binomial species names in which the first two letters of the genus and species names are combined. Exceptions to this are PELT = *Peltigera* spp., PICOR = *Pinus contorta* establishment, PICOT = *Pinus contorta* trees, PIMAR = *Picea mariana* establishment, PIMAT = *Picea mariana* trees.

	SHCA	LEGR	SPBE	JUCO	ARUV	VACA	LIBO	ROAC	ORSE	PYCH	COCA	ARCO	ASCO	GELI	CABU	DIPO	HYSP	PLSC	PTCR	PELT	PICOR	PIMAR	PICOT	PIMAT
SHCA	1	-.25	.	.	+.35	.	.	.	.	.	-.27	.	.	.	.	+.21	-.40	+.3	-.31	.	+.32	-.30	.	-.34
LEGR	-.25	1	.	.	.	.	.	.	.	.	+.22	.	.	.	.	.	.	.	.	.	.	.	.	+.23
SPBE	.	.	1	.	+.29	.	.	.	.	.	.	.	.	.	.	.	-.23	.	.	.	.	-.23	.	.
JUCO	.	.	.	1	+.21	.	.	.	.	.	.	.	.	.	.	.	-.22	.	.	.	+.21	.	.	.
ARUV	+.35	.	+.29	+.21	1	.	+.31	.	.	.	-.33	-.23	+.21	-.22	.	+.21	-.57	.	-.37	.	+.4	-.50	-.26	-.47
VACA	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-.30	.	-.27
LIBO	.	.	.	.	+.31	.	1	+.22	.	.	.	.	.	.	.	+.23	-.38	.	.	.	+.25	-.22	.	-.26
ROAC	.	.	.	.	.	.	+.22	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
ORSE	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	-.21	.	.	.	.	.	.	.
PYCH	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	-.22	+.22	-.22	.	.	-.20	.	-.20
COCA	-.27	+.22	.	.	-.33	.	.	.	.	.	1	+.28	.	.	.	.	+.47	-.25	+.35	.	-.31	+.33	.	+.31
ARCO	.	.	.	.	-.23	.	.	.	.	.	+.28	1	.	.	.	.	+.28	.	.	.	.	+.28	.	.
ASCO	.	.	.	.	+.21	.	.	.	.	.	.	.	1	.	.	.	-.23	.	.	.	.	-.22	.	-.24
GELI	.	.	.	.	-.22	.	.	.	.	.	.	.	.	1	.	.	+.22	.	+.25	.	.	.	.	.
CABU	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	-.23	.	.	.	+.28	.	.	.
DIPO	+.21	.	.	.	+.21	.	+.23	.	.	.	.	.	.	.	.	1	-.44	.	.	.	.	.	.	.
HYSP	-.40	.	-.23	-.22	-.57	.	-.38	.	-.21	-.22	+.47	+.28	-.27	+.22	-.23	-.44	1	-.28	+.44	.	-.42	+.56	+.22	+.53
PLSC	+.30	.	.	.	.	.	.	.	.	+.22	-.25	.	.	.	.	.	-.28	1	-.35	.	.	.	.	.
PTCR	-.31	.	.	.	-.37	.	.	.	.	-.22	+.35	.	.	+.25	.	.	+.44	-.35	1	.	-.25	+.33	.	+.34
PELT	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
PICOR	+.32	.	.	+.21	+.40	.	+.25	.	.	.	-.31	.	.	.	+.28	.	-.42	.	-.25	.	1	-.33	-.32	-.43
PIMAR	-.30	.	-.23	.	-.50	-.30	-.22	.	.	-.20	+.33	+.28	-.22	.	.	.	+.56	.	+.33	.	-.33	1	+.22	+.65
PICOT	.	.	.	.	-.26	.	.	.	.	.	.	.	.	.	.	.	+.22	.	.	.	-.32	+.22	1	+.24
PIMAT	-.34	+.23	.	.	-.47	-.27	-.26	.	.	-.20	+.31	.	-.24	.	.	.	+.53	.	+.34	.	-.43	+.65	+.24	1

Table 3-12. Spearman's rank correlation coefficients for understorey species in 1989 at Whirlpool. Only significant (p <= 0.05) correlations with absolute values equal to or greater than 0.20 are shown. Four-letter codes represent the binomial species names in which the first two letters of the genus and species names are combined. Exceptions to this are PELT = *Peltigera* spp., PICOR = *Pinus contorta* establishment, PICOT = *Pinus contorta* trees, PIMAR = *Picea mariana* establishment, PIMAT = *Picea mariana* trees.

	SHCA	LEGR	SPBE	JUCO	ARUV	VACA	LIBO	ROAC	ORSE	PYCH	COCA	ARCO	ASCO	GELI	CABU	DIPO	HYSP	PLSC	PTCR	PELT	PICOR	PIMAR	PICOT	PIMAT
SHCA	1	-.21	.	+.25	+.50	+.29	+.22	.	.	.	.	.	.	.	.	+.32	-.37	+.38	-.38	.	+.42	-.49	.	-.45
LEGR	-.21	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+.22	.	.	.	.	.
SPBE	.	.	1	.	+.20	.	.	.	.	.	.	.	.	.	.	.	-.31	.	.	-.33	.	-.20	.	.
JUCO	+.25	.	.	1	+.33	.	.	.	.	.	.	.	.	.	.	+.21	-.30	+.24	.	.	+.34	-.36	.	-.28
ARUV	+.50	.	+.20	+.33	1	+.28	+.21	.	.	.	.	-.26	+.2	.	.	+.48	-.58	+.44	-.32	.	+.5	-.63	.	-.57
VACA	+.29	.	.	.	+.28	1	+.25	.	.	.	.	.	.	.	.	.	-.23	.	-.21	.	+.33	-.34	.	-.33
LIBO	+.22	.	.	.	+.21	+.25	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+.21	-.22	.	.
ROAC	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	-.21	.	.	.	.	.
ORSE	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
PYCH	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
COCA	.	.	.	.	.	.	.	.	.	.	1	+.31	.	.	.	-.21	+.28	-.24	.	.	.	+.23	.	.
ARCO	.	.	.	.	-.26	.	.	.	.	.	+.31	1	.	.	.	.	+.23	.	.	.	-.20	+.28	.	+.26
ASCO	.	.	.	.	+.2	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
GELI	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
CABU	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
DIPO	+.32	.	.	+.21	+.48	.	.	.	.	.	-.21	.	.	.	.	1	-.56	+.43	-.32	.	+.39	-.44	.	-.40
HYSP	-.37	.	-.31	-.30	-.58	-.23	.	.	.	.	+.28	+.23	.	.	.	-.56	1	-.68	+.29	+.21	-+.5	+.56	.	+.49
PLSC	+.38	.	.	+.24	+.44	.	.	.	.	.	-.24	.	.	.	.	+.43	-.68	1	-.32	.	+.44	-.45	.	-.35
PTCR	-.38	+.22	.	.	-.32	-.21	.	-.21	.	.	.	.	.	.	.	-.32	+.29	-.32	1	.	-.32	+.29	.	+.23
PELT	.	.	-.33	.	.	.	.	.	.	.	.	.	.	.	.	.	+.21	.	.	1	.	.	.	.
PICOR	+.42	.	.	+.34	+.50	+.33	+.21	.	.	.	.	-.20	.	.	.	+.39	-.51	+.44	-.32	.	1	-.53	.	-.45
PIMAR	-.49	.	-.20	-.36	-.63	-.34	-.22	.	.	.	+.23	+.28	.	.	.	-.44	+.56	-.45	+.29	.	-.53	1	.	+.73
PICOT	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
PIMAT	-.45	.	.	-.28	-.57	-.33	.	.	.	.	.	+.26	.	.	.	-.40	+.49	-.35	+.23	.	-.45	+.73	.	1

mature and immature, *Cornus canadensis*, *Arnica cordifolia* and *Ptilium crista-castrensis*. It was negatively correlated with immature *Pinus contorta*, *Arctostaphylos uva-ursi*, *Shepherdia canadensis*, and *Linnaea borealis*; and with the mosses *Dicranum polysetum* and *Pleurozium schreberi*. These two species groups, those positively and those negatively correlated with *Hylocomium splendens*, were positively correlated within groups and negatively correlated between groups.

This correlational pattern was even more strongly evident in 1989 (Table 3-12) except that *Cornus canadensis* was correlated with fewer species.

3.3.4.4 Hector

The Hector stand has a patch of *Picea engelmannii* and *Abies lasiocarpa* trees behind the fire margin across its low-slope, northwest corner from which a wave of immature *Picea* and *Abies* is spreading southeastward and up-slope into the pine stand (Chapter 2). In 1967 only *Cornus canadensis* (Figure 3-12b) and *Dicranum undulatum* were positively correlated with the younger spruce and fir density (Table 3-13), but by 1989 *Menziesia ferruginea* (Figure 3-11b), *Vaccinium scoparium* and *Arnica cordifolia* (Figure 3-12c) were also correlated with young spruce density (Table 3-14). In both study years *Pinus contorta* was negatively correlated with *Menziesia ferruginea* and *Ledum groenlandicum* (Figure 3-11c).

In both 1967 and 1989 the dominant understorey species at Hector, *M. ferruginea*, had strong positive correlations with *Pleurozium schreberi* and *L. groenlandicum*, but was negatively correlated with three positively correlated species: *Shepherdia canadensis* (Figure 3-11a), *Linnaea borealis* (Figure 3-12a), and *Stereocaulon* spp. (Tables 3-13 and 3-14).

3.3.5 Species Temporal Stability

The temporal stability of species between 1967 and 1989, as measured by correlating species cover in quadrats between the two study years, tended to be high for shrubs and dwarf shrubs and low for forbs and graminoids (Table 3-15). Exceptions to

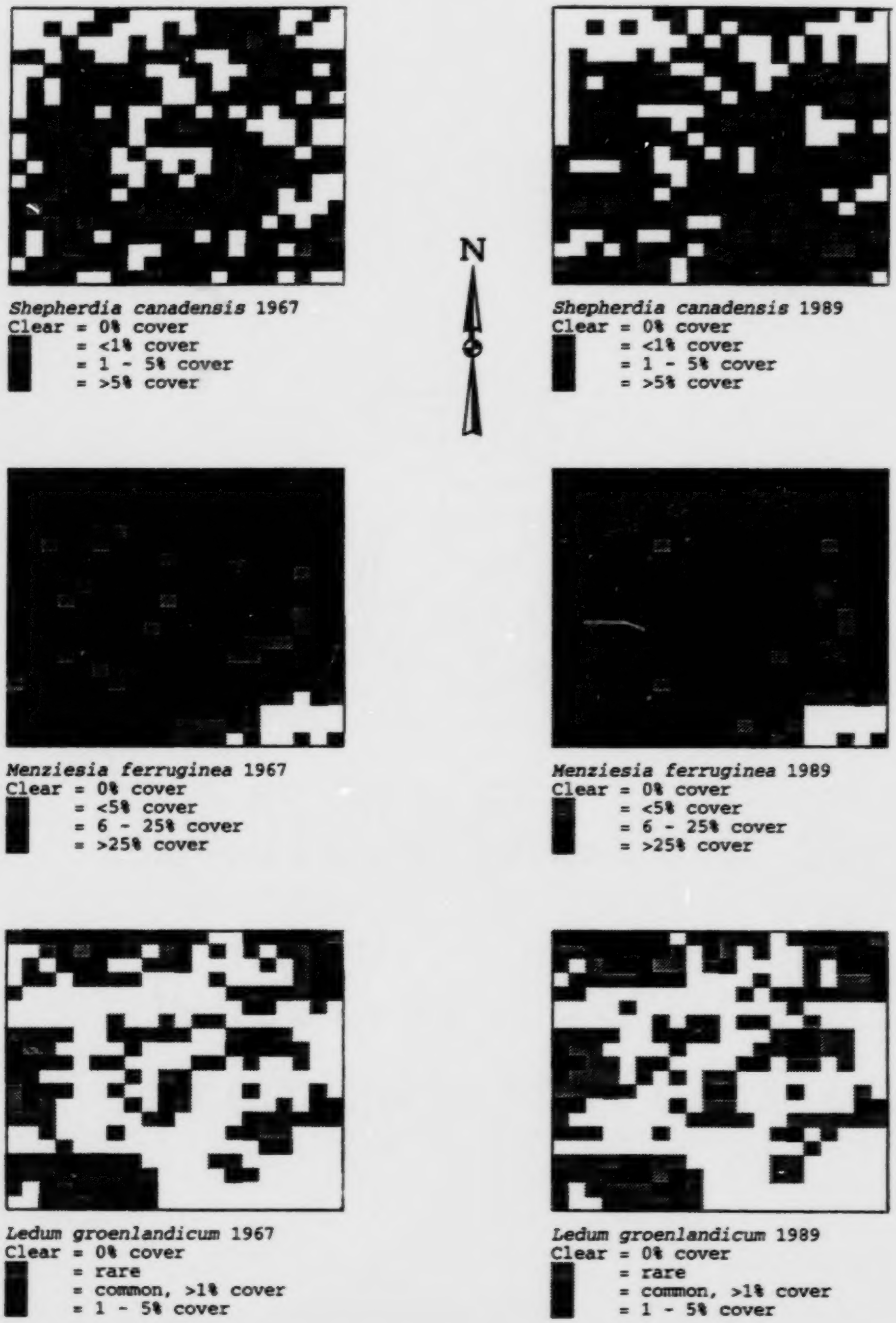
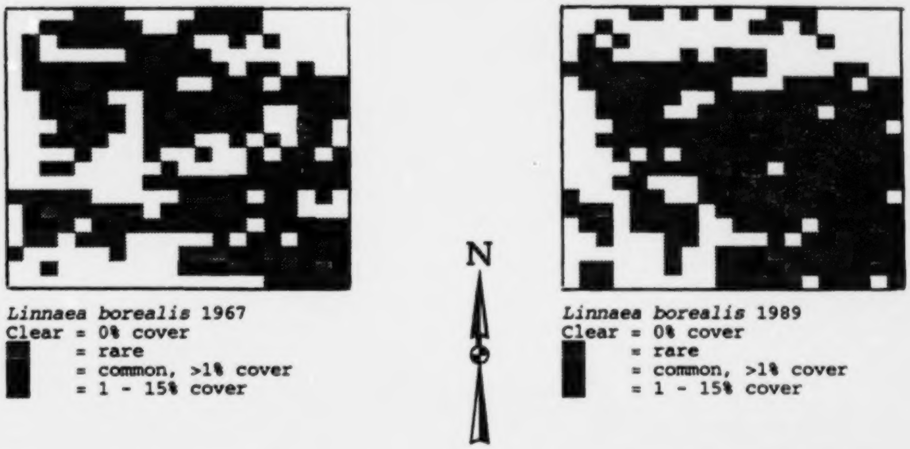
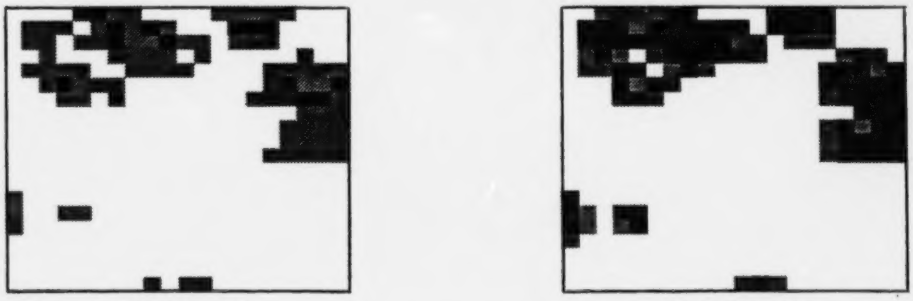

Shepherdia canadensis 1967
Clear = 0% cover
= <1% cover
= 1 - 5% cover
= >5% cover
N
Shepherdia canadensis 1989
Clear = 0% cover
= <1% cover
= 1 - 5% cover
= >5% cover
Menziesia ferruginea 1967
Clear = 0% cover
= <5% cover
= 6 - 25% cover
= >25% cover
Menziesia ferruginea 1989
Clear = 0% cover
= <5% cover
= 6 - 25% cover
= >25% cover
Ledum groenlandicum 1967
Clear = 0% cover
= rare
= common, >1% cover
= 1 - 5% cover
Ledum groenlandicum 1989
Clear = 0% cover
= rare
= common, >1% cover
= 1 - 5% cover

Figure 3-11. Cover distribution maps of *Shepherdia canadensis*, *Menziesia ferruginea*, and *Ledum groenlandicum*, in 1967 and 1989 at the Hector permanent plot.



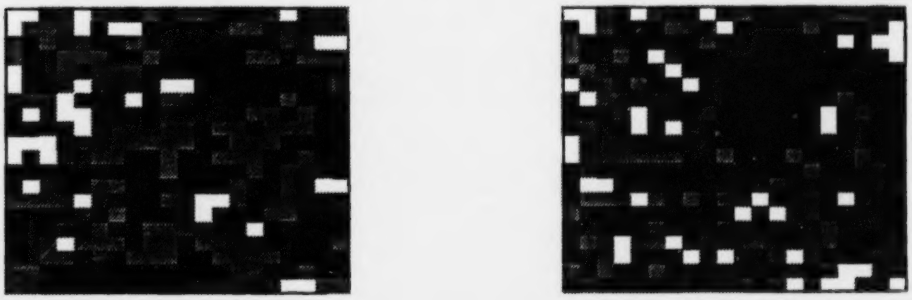
Linnaea borealis 1967
Clear = 0% cover
▨ = rare
■ = common, >1% cover
■ = 1 - 15% cover

Linnaea borealis 1989
Clear = 0% cover
▨ = rare
■ = common, >1% cover
■ = 1 - 15% cover



Cornus canadensis 1967
Clear = 0% cover
▨ = rare
■ = common, >1% cover
■ = 1 - 5% cover

Cornus canadensis 1989
Clear = 0% cover
▨ = rare
■ = common, >1% cover
■ = 1 - 5% cover



Arnica cordifolia 1967
Clear = 0% cover
▨ = rare
■ = common, >1% cover
■ = 1 - 5% cover

Arnica cordifolia 1989
Clear = 0% cover
▨ = rare
■ = common, >1% cover
■ = 1 - 5% cover

Figure 3-12. Cover distribution maps of *Linnaea borealis*, *Cornus canadensis*, and *Arnica cordifolia* in 1967 and 1989 at the Hector permanent plot.

Table 3-13. Spearman's rank correlation coefficients for understorey species in 1967 at Hector. Only significant ($p <= 0.05$) correlations with absolute values equal to or greater than 0.20 are shown. Four-letter codes represent the binomial species names in which the first two letters of the genus and species names are combined. Exceptions to this are CARX = *Carex* spp., CLDN = *Cladonia* spp. PELT = *Peltigera* spp., STCN = *Stereocaulon* spp., PICOT = *Pinus contorta* trees, PIENR = *Picea engelmannii* establishment, PIENT = *Picea engelmannii* trees, ABLAR = *Abies lasiocarpa* establishment.

	SHCA	LEGR	MEFE	JUCO	VAMY	VASC	LIBO	ORSE	COCA	ARCO	CARX	DIUN	HYSP	PLSC	PTCR	CLDN	PELT	STCN	PIENR	ABLAR	PICOT	PIENT
SHCA	1	-.26	-.47	.	.	.	+.31	.	.	.	.	.	.	-.27	.	.	.	+.25	.	.	.	.
LEGR	-.26	1	+.4	.	.	.	-.27	.	.	.	-.21	.	.	+.20	.	.	.	.	.	.	-.23	.
MEFE	-.47	+.4	1	.	.	-.23	-.44	.	.	.	.	.	.	+.50	.	-.25	.	-.42	+.26	.	-.20	.
JUCO	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
VAMY	.	.	.	.	1	.	.	.	.	.	.	-.24	.	.	.	.	.	.	.	.	.	.
VASC	.	.	-.23	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	-.22	.	.	.
LIBO	+.31	-.27	-.44	.	.	.	1	.	.	.	+.32	.	.	-.32	.	.	.	+.22	.	.	.	.
ORSE	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
COCA	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+.36	+.20	.	.
ARCO	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
CARX	.	-.21	.	.	.	.	+.32	.	.	.	1	.	.	-.20	.	.	.	.	.	.	.	.
DIUN	.	.	.	.	-.24	.	.	.	.	.	.	1	.	.	.	.	.	.	+.33	+.22	.	+.20
HYSP	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
PLSC	-.27	+.2	+.5	.	.	.	-.32	.	.	.	-.20	.	.	1	+.28	.	.	-.24	.	.	.	.
PTCR	.	.	.	.	.	.	.	.	.	.	.	.	.	+.28	1	.	.	.	.	.	.	.
CLDN	.	.	-.25	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+.21	.	.	.	.
PELT	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
STCN	+.25	.	-.42	.	.	.	+.22	.	.	.	.	.	.	-.24	.	+.21	.	1	.	.	.	.
PIENR	.	.	+.26	.	.	-.22	.	.	+.36	.	.	+.33	.	.	.	.	.	.	1	+.40	.	+.27
ABLAR	.	.	.	.	.	.	.	.	+.20	.	.	+.22	.	.	.	.	.	.	+.40	1	.	+.22
PICOT	.	-.23	-.20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	-.20
PIENT	.	.	.	.	.	.	.	.	.	.	.	+.20	.	.	.	.	.	.	+.27	+.22	-.21	1

Table 3-14. Spearman's rank correlation coefficients for understorey species in 1989 at Hector. Only significant (p <= 0.05) correlations with absolute values equal to or greater than 0.20 are shown. Four-letter codes represent the binomial species names in which the first two letters of the genus and species names are combined. Exceptions to this are CARX = *Carex* spp., CLDN = *Cladonia* spp. PELT = *Peltigera* spp., STCN = *Stereocaulon* spp., PICOT = *Pinus contorta* trees, PIENR = *Picea engelmannii* establishment, PIENT = *Picea engelmannii* trees, ABLAR = *Abies lasiocarpa* establishment.

	SHCA	LEGR	MEFE	JUCO	VAMY	VASC	LIBO	ORSE	COCA	ARCO	CARX	DIUN	HYSP	PLSC	PTCR	CLDN	PELT	STCN	PIENR	ABLAR	PICOT	PIENT
SHCA	1	-.34	-.47	.	.	.	+.44	.	.	.	.	.	.	-.24	.	.	.	.	.	.	.	-.25
LEGR	-.34	1	+.44	.	.	.	-.38	.	.	.	.	.	.	+.31	.	.	.	.	.	.	-.25	.
MEFE	-.47	+.44	1	-.20	.	.	-.45	-.21	.	.	-.30	.	.	+.45	.	-.25	-.26	-.27	+.30	.	-.22	+.24
JUCO	.	.	-.20	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
VAMY	.	.	.	.	1	.	.	.	-.30	.	.	-.27	.	.	.	.	.	.	.	-.21	.	-.27
VASC	.	.	.	.	.	1	.	.	+.25	.	.	.	.	.	.	.	.	.	+.27	.	.	.
LIBO	+.44	-.38	-.45	.	.	.	1	.	.	.	.	.	.	-.38	.	.	.	+.22	.	.	+.27	.
ORSE	.	.	-.21	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
COCA	.	.	.	.	-.30	+.25	.	.	1	+.23	.	+.26	.	.	.	.	.	.	+.30	+.23	.	+.21
ARCO	.	.	.	.	.	.	.	.	+.23	1	.	.	.	.	.	.	.	.	+.23	.	.	.
CARX	.	.	-.30	.	.	.	.	.	.	.	1	.	.	-.32	.	.	.	.	-.20	.	.	.
DIUN	.	.	.	.	-.26	.	.	.	+.26	.	.	1	.	.	.	.	.	.	.	.	.	.
HYSP	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+.22	.	+.28	.	.	+.21	.	.
PLSC	-.24	+.31	+.45	.	.	.	-.38	.	.	.	-.32	.	.	1	.	-.27	-.26	.	+.20	.	-.20	.
PTCR	.	.	.	.	.	.	.	.	.	.	.	.	+.22	.	1	.	.	.	.	.	.	.
CLDN	.	.	-.25	.	.	.	.	.	.	.	.	.	.	-.27	.	1	.	+.23	.	.	.	.
PELT	.	.	-.26	.	.	.	.	.	.	.	.	.	+.28	-.26	.	.	1	.	.	.	+.24	.
STCN	.	.	-.27	.	.	.	+.22	.	.	.	.	.	.	.	.	+.23	.	1	.	.	.	.
PIENR	.	.	+.30	.	.	+.27	.	.	+.30	+.23	-.20	.	.	+.20	.	.	.	.	1	+.34	.	+.43
ABLAR	.	.	.	.	-.21	.	.	.	+.23	.	.	.	+.21	.	.	.	.	.	+.34	1	.	+.21
PICOT	.	-.25	-.22	.	.	.	+.27	.	.	.	.	.	.	-.20	.	.	+.24	.	.	.	1	-.23
PIENT	-.25	.	+.24	.	-.27	.	.	.	+.21	.	.	.	.	.	.	.	.	.	+.43	+.22	-.23	1

Table 3-15. Spearman's rank correlation coefficients for understorey species cover in quadrats (n=400) between 1967 and 1989. N.S. = non-significant correlation coefficients (p>0.05).

SPECIES	ATHABASCA	SUNWAPTA	WHIRLPOOL	HECTOR
SHRUBS				
Shepherdia canadensis	0.68	0.51	0.66	0.71
Ledum groenlandicum		0.68	0.80	0.81
Menziesia ferruginea				0.76
Rhododendron albiflorum				0.75
Amelanchier alnifolia	0.66			
Spiraea betulifolia			0.76	
Juniperus communis	0.60	0.71	0.68	0.66
Rosa acicularis	0.58	0.57	0.45	
Salix spp.	0.70	0.50	0.54	
Alnus crispa		0.71		
Viburnum edule			0.74	
DWARF SHRUBS				
Arctostaphylos uva-ursi	0.32	0.27	0.65	
Linnaea borealis	0.52	0.14	0.23	0.58
Vaccinium caespitosum		0.45	0.62	
Vaccinium myrtillus			0.64	0.46
Vaccinium scoparium				0.13
Vaccinium vitis-idaea		0.73		
FORBS				
Fragaria virginiana	0.12	0.54	0.79	
Chimaphila umbellata		0.55	0.66	
Orthilia secunda	0.33	0.39	0.49	0.64
Pyrola chlorantha	0.23	0.10	0.27	
Cornus canadensis		0.73	0.59	0.84
Achillea millefolium	0.35	0.46		
Antennaria howellii	0.33	0.45		
Antennaria rosea	0.37			
Arnica cordifolia		0.67	0.85	0.53
Aster ciliolatus		0.58	0.61	
Aster conspicuus		0.70	0.62	
Senecio streptanthifolius	0.32			
Solidago spp.	0.37	0.31	0.67	
Melampyrum lineare		0.10		
Geocaulon lividum			0.65	
Viola adunca	0.38			
Campanula rotundifolia	0.27			
Epilobium angustifolium				0.45
Gentianella amarella	N.S.	N.S.		
Calypso bulbosa	0.26		0.31	
Goodyera oblongifolia		0.18	0.12	

Table 3-15 Continued.

SPECIES	**ATHABASCA**	**SUNWAPTA**	**WHIRLPOOL**	**HECTOR**
PTERIDOPHYTES				
Lycopodium complanatum		0.25		
GRAMINOIDS				
Elymus innovatus	0.15	0.35	0.22	
Festuca saximontana	0.29			
Carex spp.	N.S.			0.21
BRYOPHYTES				
Mosses*	0.58			
Dicranum undulatum				0.28
Dicranum polysetum		N.S.	0.28	
Hylocomium splendens		0.21	0.72	0.27
Pleurozium schreberi		0.62	0.31	0.60
Polytrichum juniperum				0.20
Ptilium crista-castrensis		0.22	0.41	0.31
Lichens*	N.S.	0.47		
Cladonia spp.				0.23
Peltigera spp.		0.20	0.18	0.28
Stereocaulon spp.				0.34

* Mosses and lichens not identified to species in 1967 study at Athabasca (see Methods)

this generalization were *Cornus canadensis*, *Arnica cordifolia*, and the two *Aster* species, which, although forbs, had high stability between 1967 and 1989. The vascular species with the lowest temporal stability were the two annuals, *Gentianella amarella* and *Melampyrum lineare*, and *Goodyera oblongifolia* and *Carex* (Table 3-15). While temporal stability of most species was fairly consistent across the four sites, some species were highly variable. The stability of *Fragaria virginiana* was low at xeric Athabasca, higher at mesic Sunwapta, and very high at moist Whirlpool. *Linnaea borealis* had high stability in the two species-poor sites (Athabasca and Hector), and low stability in the species-rich sites (Sunwapta and Whirlpool). *Arctostaphylos uva-ursi* and *Solidago* sp. both displayed lower stabilities at Athabasca and Sunwapta and higher stabilities at Whirlpool (Table 3-15). The stabilities of the feather mosses *Hylocomium splendens* and *Pleurozium schreberi* also varied among the sites. At Sunwapta and Hector *H. splendens* had low stability and *P. schreberi* had high stability, whereas at Whirlpool the reverse was true (Table 3-15).

3.3.6 Quadrat Classification and Transition

3.3.6.1 Athabasca

The classification of quadrats at Athabasca was dominated by *Arctostaphylos uva-ursi* which was given a partial r^2 weighting by discriminant analysis of almost 0.9 (Table 3-16). Despite its relatively low stand cover, *Juniperus communis* had the next strongest partial r^2 weighting of 0.67.

The 400 quadrats at Athabasca fell into only 3 of the 5 classes in 1967 and the great majority of them fell into Class 1 (Table 3-17) which characterized quadrats with low vascular plant cover (Table 3-16). 48 quadrats had slightly higher *Arctostaphylos uva-ursi* covers and thus were classified into Class 2 (Tables 3-16 and 3-17).

By 1989 a transition of 43% of Class 1 quadrats and 60% of Class 2 quadrats to Class 3 was seen and indicated a large increase in *A. uva-ursi* cover in these quadrats. This 10-fold increase of Class 3 occurred mostly in the southern half of the stand (Figure 3-13) where tree density and canopy cover were lower (Figures 2-12 and 2-13). Increases in the covers of *Shepherdia canadensis* and *Linnaea borealis* resulted in the first

Table 3-16. Description of the classification units derived from cluster analysis of quadrats at the Athabasca site in terms of mean species cover. Species are listed in order of their importance in the classification. Highlighted cover values indicate classes representing minimum or maximum covers for that species.

SPECIES	**PARTIAL** r^2	**CLASSES** 1	2	3	4	5
Arctostaphylos uva-ursi	0.894	**5.9**	19.9	**39.6**	16.7	25.1
Juniperus communis	0.671	**.5**	1.1	1.6	1.0	**45.1**
Shepherdia canadensis	0.489	**1.3**	3.5	6.1	**20.3**	3.3
Linnaea borealis	0.100	**1.3**	3.8	4.1	**10.4**	5.1
Elymus innovatus	0.077	**1.2**	6.4	**8.6**	7.7	8.0

Table 3-17. Frequency of transition of quadrat classification from 1967 to 1989 at the Athabasca site. Highlighted frequencies along the principle diagonal indicate number of quadrats not changing classification between 1967 and 1989.

		1989 CLASSES					
		1	**2**	**3**	**4**	**5**	**1967 TOTAL**
1967 CLASSES	**1**	**52**	83	143	46	7	331
	2	2	**12**	29	5	0	48
	3	1	4	**9**	3	0	17
	4	0	0	0	**0**	0	0
	5	0	0	0	0	**0**	0
1989 TOTAL		55	99	181	54	7	396

appearance of Class 4 in 1989. Class 4 quadrats were largely restricted to the old river island in the north-central portion of the plot (Figure 3-13). The first appearance of 7 Class 5 quadrats in 1989 reflected the growth and spread of isolated *Juniperus communis* patches (Tables 3-16 and 3-17). By 1989, Class 1 quadrats, which had earlier dominated the site, were restricted to small patches on the old river island and to the lower terrace in the southwest corner of the site where moss cover was high (Figure 3-13).

3.3.6.2 Sunwapta

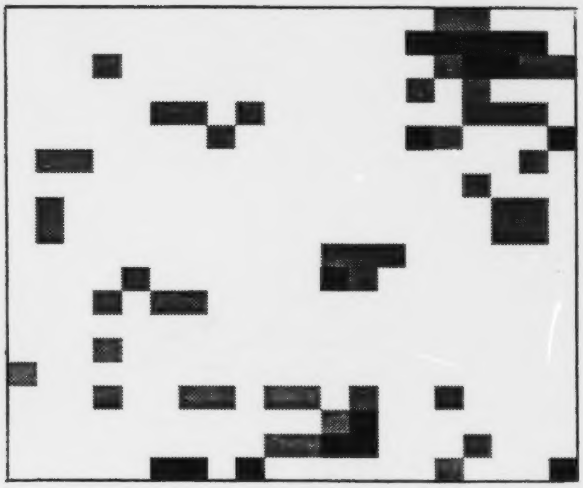
The quadrat classification at Sunwapta was strongly influenced by the cover-dominant species, *Shepherdia canadensis*. In 1967 over half the quadrats fell into Class 2, indicating low *Shepherdia* cover, and a further quarter of the quadrats fell into Classes 4 and 5, indicating high to very high Shepherdia cover (Tables 3-18 and 3-19). The rest of the quadrats fell into Classes 1 and 3 indicating moderate *Shepherdia* covers close to the stand average. Classes 4 and 5 tended to be more common in the east portion of the stand whereas Class 2 was more common in the west portion (Figure 3-14)

The classification of the 400 quadrats in 1989 saw a transition from the classes representing extremes in *Shepherdia* cover (Classes 2, 4 and 5) to classes representing moderate *Shepherdia* cover (Classes 1 and 3) in which the latter two classes increased from 26% to 79% of the quadrats (Table 3-19). Despite these large *Shepherdia* cover changes in individual quadrats (see Figure 3-7a), the overall cover of *Shepherdia* at Sunwapta was little changed in 1989 (Table 3-3). The large increase in Class 1 also indicated significant growth and spread of *Juniperus communis* cover at Sunwapta between 1967 and 1989 (Table 3-19). Figure 3-14 shows no discernable pattern in the dispersion of vegetation classes in 1989.

3.3.6.3 Whirlpool

The classification of quadrats at Whirlpool was not dominated by a single species as was the case at Sunwapta. *Shepherdia canadensis* and *Juniperus communis* were given almost equal partial r^2 weightings by the discriminant analysis (Table 3-20). Two other species were also given partial r^2 weightings greater than 0.5: *Cornus canadensis* and

1967



1989

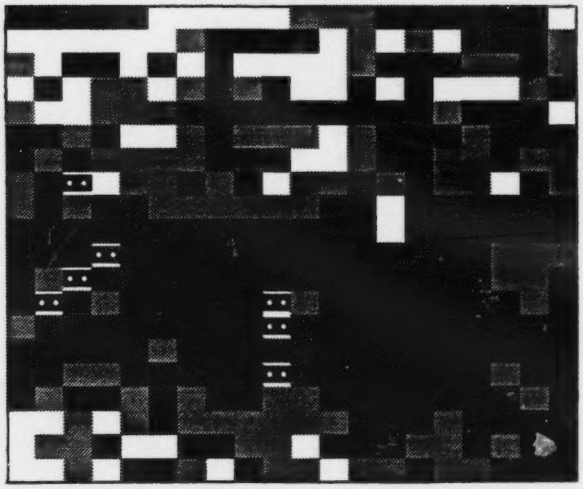


Figure 3-13. Distribution of vascular understorey species classification units in 1967 and 1989 at Athabasca.

= Class 1
▨ = Class 2
▩ = Class 3
■ = Class 4
⊡ = Class 5

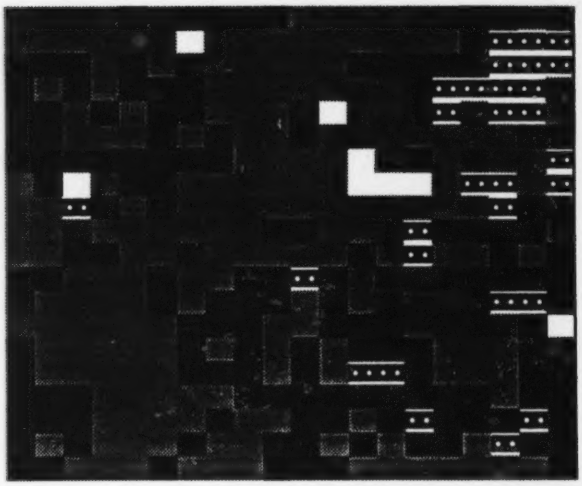
Table 3-18. Description of the classification units derived from cluster analysis of quadrats at the Sunwapta site in terms of mean species cover. Species are listed in order of their importance in the classification. Highlighted cover values indicate classes representing minimum or maximum covers for that species.

SPECIES	**PARTIAL**			**CLASSES**		
	r^2	**1**	**2**	**3**	**4**	**5**
Shepherdia canadensis	0.958	9.7	**2.2**	9.6	20.0	**38.0**
Juniperus communis	0.487	**12.7**	1.4	1.6	2.2	**.6**
Elymus innovatus	0.248	**3.5**	1.1	3.2	1.6	**.3**
Linnaea borealis	0.089	**3.8**	**1.0**	3.4	1.8	1.2

Table 3-19. Frequency of transition of quadrat classification from 1967 to 1989 at Sunwapta site. Highlighted frequencies along the principle diagonal indicate number of quadrats not changing classification between 1967 and 1989.

		1989 CLASSES					
		1	**2**	**3**	**4**	**5**	**1967 TOTAL**
1967 CLASSES	**1**	**8**	0	0	0	0	8
	2	48	**42**	113	2	0	205
	3	19	6	**62**	10	0	97
	4	13	0	38	**10**	0	61
	5	3	0	12	13	**1**	29
1989 TOTAL		91	48	223	35	1	400

1967



1989

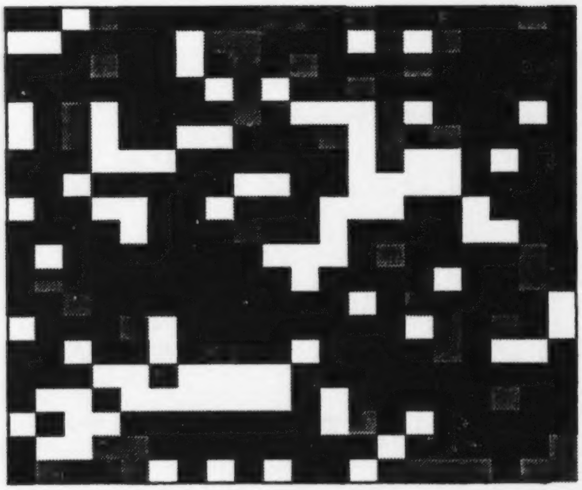


Figure 3-14. Distribution of vascular understorey species classification units in 1967 and 1989 at Sunwapta.

□ = Class 1
▩ = Class 2
■ = Class 3
■ = Class 4
⁚⁚ = Class 5

Table 3-20. Description of the classification units derived from cluster analysis of quadrats at the Whirlpool site in terms of mean species cover. Species are listed in order of their importance in the classification. Highlighted cover values indicate classes representing minimum or maximum covers for that species.

SPECIES	**PARTIAL**	**CLASSES**				
	r^2	**1**	**2**	**3**	**4**	**5**
Shepherdia canadensis	0.654	**.9**	**10.4**	5.5	1.2	3.8
Juniperus communis	0.632	**.4**	.9	1.4	.5	**12.8**
Cornus canadensis	0.529	**1.2**	4.4	3.9	**10.4**	2.4
Vaccinium caespitosum	0.504	**.7**	2.6	**8.8**	1.4	1.5
Linnaea borealis	0.260	**1.2**	2.9	**6.3**	2.6	2.6
Arctostaphylos uva-ursi	0.120	.5	4.3	2.4	**.3**	2.9

Table 3-21. Frequency of transition of quadrat classification from 1967 to 1989 at Whirlpool site. Highlighted frequencies along the principle diagonal indicate number of quadrats not changing classification between 1967 and 1989.

		1989 CLASSES					
		1	**2**	**3**	**4**	**5**	**1967 TOTAL**
1967 CLASSES	**1**	**136**	110	56	49	20	371
	2	1	**0**	0	0	1	2
	3	2	4	**5**	1	1	13
	4	2	0	0	**1**	0	3
	5	0	1	2	0	**8**	11
1989 TOTAL		141	115	63	51	30	400

Vaccinium caespitosum.

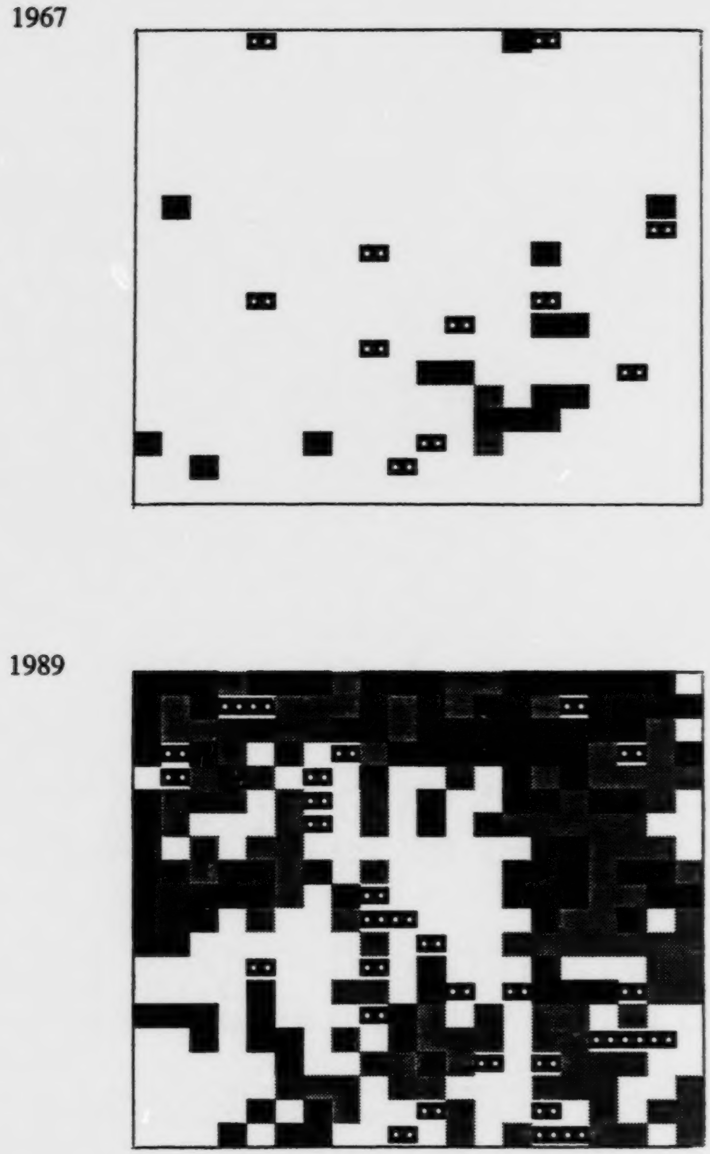
Class 1 includes quadrats with low covers of the major vascular species listed above and in 1967 it represented almost 93% of the quadrats at Whirlpool. All four other classes were present in 1967 but none represented more than 3.3% of the quadrats.

By 1989 Class 1 was still the largest class, but had fallen to 35% of the quadrats. The large transition of 110 quadrats from Class 1 to Class 2 indicated significant increases in *S. canadensis* cover in these quadrats (Table 3-21). The majority of these Class 2 quadrats were found on the upper terrace in the western half of the stand (Figure 3-15, compare with Figure 1-4). The transition from Class 1 to Class 3 of a further 56 quadrats, again mostly found on the upper terrace (Figure 3-15), indicated large increases in *V. caespitosum* and *L. borealis* covers, and moderate increases in *S. canadensis* cover (Tables 3-20 and 3-21). The transition from Class 1 to Class 4 occurred mostly on the lower terrace and indicated increased cover of *Cornus canadensis*. While Class 5, which indicates high *Juniperus communis* cover (Table 3-20), tripled in size between 1967 and 1989, it was also the most stable. Only 3 of the 11 1967 Class 5 quadrats were transferred into other classes in 1989 (Table 3-21). In both study years the majority of Class 5 quadrats were concentrated near the ridge which separates the two terraces (Figure 3-15, compare with Figure 1-4)

3.3.6.4 Hector

As at Whirlpool, the classification of quadrats at Hector was strongly influenced by the cover of the dominant shrub, which at this site was *Menziesia ferruginea* (Table 3-22). Furthermore, according to the discriminant analysis performed on the classification, *Shepherdia canadensis* was the only other species to be given a significant partial r^2 weighting. Classes 1, 2, 3 and 5 represented quadrats with very high, high, moderate, and low covers respectively of *M. ferruginea*. Class 4 represented quadrats with high *S. canadensis* and low *M. ferruginea* covers (Table 3-22).

The quadrats represented by Classes 1 - 3, indicating higher *M. ferruginea* cover, remained much the same between 1967 and 1989, although there was movement between these classes (Table 3-23). Some of this movement may be related to my under-



1967

1989

Figure 3-15. Distribution of vascular understorey species classification units in 1967 and 1989 at Whirlpool.

= Class 1

▨ = Class 2

■ = Class 3

■ = Class 4

⊡ = Class 5

Table 3-22. Description of the classification units derived from cluster analysis of quadrats at the Hector site in terms of mean species cover. Species are listed in order of their importance in the classification. Highlighted cover values indicate classes representing minimum or maximum covers for that species.

SPECIES	PARTIAL r^2	CLASSES 1	2	3	4	5
Menziesia ferruginea	0.981	**63.3**	38.0	20.0	**6.3**	7.2
Shepherdia canadensis	0.436	**.8**	1.5	3.0	**12.3**	2.1
Juniperus communis	0.028	< .1	< .1	< .1	.1	< .1

Table 3-23. Frequency of transition of quadrat classification from 1967 to 1989 at Hector site. Highlighted frequencies along the principle diagonal indicate number of quadrats not changing classification between 1967 and 1989.

		1989 CLASSES 1	2	3	4	5	1967 TOTAL
1967 CLASSES	**1**	**3**	65	7	0	0	75
	2	1	**115**	37	1	2	156
	3	0	20	**37**	2	11	70
	4	0	2	10	**20**	22	54
	5	0	1	12	1	**31**	45
1989 TOTAL		4	203	103	24	66	400

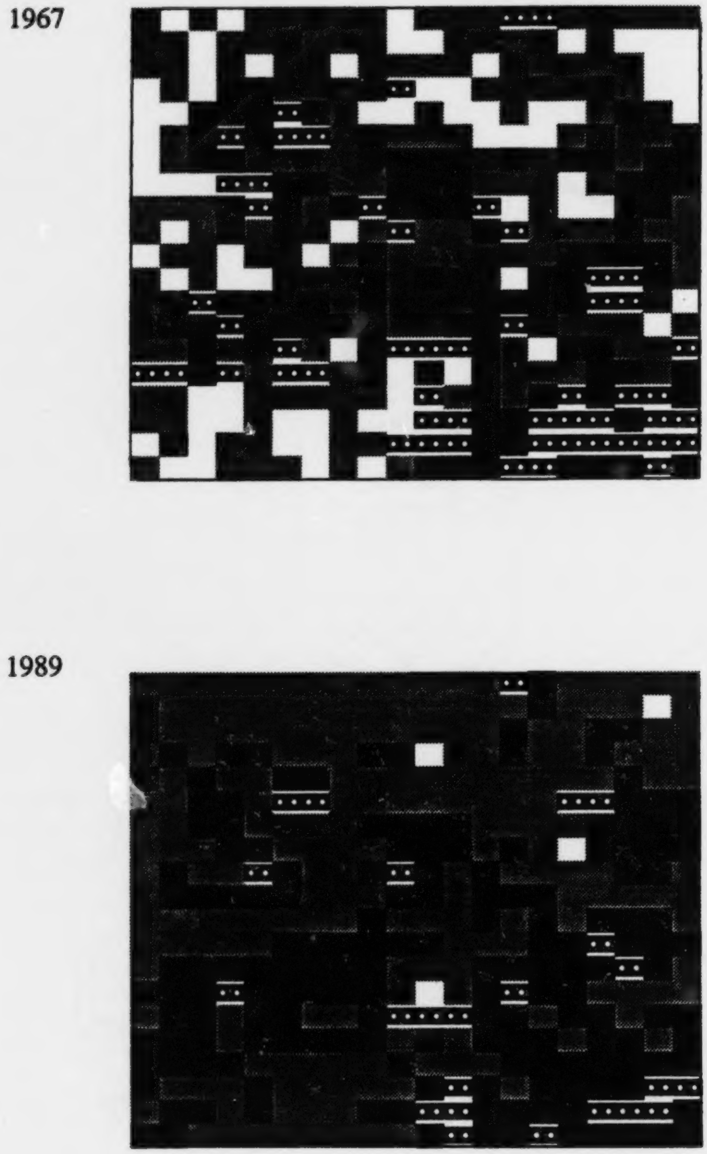


Figure 3-16. Distribution of vascular understorey species classification units in 1967 and 1989 at Hector.

= Class 1
■ = Class 2
■ = Class 3
■ = Class 4
▣ = Class 5

-estimation of *M. ferruginea* cover in 1989 relative to Hnatiuk's estimations in 1967 (Table 3-2). The grouping of Classes 1 - 3 represented over 75% of the quadrats in both study years (Table 3-23).

Although the remaining quadrats with low *Menziesia* cover and higher *Shepherdia* cover (Classes 4 and 5) were found in patches throughout the site in both study years, they were especially concentrated in the southeast corner (Figure 3-16). In this area, Class 4 and 5 quadrats were found under densely stocked, small-DBH pine trees along the crest of a steep ravine, and along the open exposed sides of the ravine (Figure 3-16; see Figures 1-5 and 2-14).

3.3.7 Site Similarity

The two sites with the highest similarity to each other according to the qualitative Jaccard and quantitative Sørenson measures were Sunwapta and Whirlpool; Athabasca and Hector showed the lowest similarity (Table 3-24). According to the Sørenson measure, Sunwapta and Whirlpool also exhibited low similarity to Hector. Between 1967 and 1989 the degree of similarity among sites, according to the Sørenson index, increased for all sites except Sunwapta and Hector where it declined. In contrast, the qualitative Jaccard measure indicated declines in similarity between Athabasca and the two Moist Class sites (Whirlpool and Hector), and between Sunwapta and the two Moist Class sites (Table 3-24).

When quantitative similarities were calculated between the 1967 and 1989 understorey vascular plant communities at a particular site, Whirlpool showed the least similarity and Hector showed the greatest similarity between the two years (Table 3-24). Thus, quantitative similarities between years were lowest at the site where the greatest increase in vascular understorey cover was seen, and highest where little cover change occurred.

The qualitative Jaccard measure gave Athabasca the lowest and Hector the highest degree of similarity between the two years, meaning that the former was more unstable floristically than the latter. The difference in ranking of site similarities between the qualitative Jaccard and quantitative Sørenson indices reflects the fact that the Jaccard index is influenced solely by changes in species presence while the Sørenson index is also influenced by cover.

Table 3-24. Indices of similarity* of permanent reference plots based on vascular understorey species cover data for 1967 and 1989.

SITE	YEAR	JACCARD	SØRENSON (Quantitative)
Athabasca & Sunwapta	1967	0.333	0.315
	1989	0.339	0.497
Athabasca & Whirlpool	1967	0.346	0.271
	1989	0.291	0.412
Athabasca & Hector	1967	0.217	0.039
	1989	0.191	0.060
Sunwapta & Whirlpool	1967	0.525	0.338
	1989	0.483	0.672
Sunwapta & Hector	1967	0.357	0.144
	1989	0.315	0.100
Whirlpool & Hector	1967	0.354	0.034
	1989	0.400	0.126
Athabasca	1967 and 1989	0.641	0.334
Sunwapta	1967 and 1989	0.737	0.635
Whirlpool	1967 and 1989	0.702	0.291
Hector	1967 and 1989	0.846	0.889

* Jaccard (1929), Bray and Curtis (1957); see also Greig-Smith (1983)

3.4 DISCUSSION

La Roi and Hnatiuk (1980) used a 5-point scale of "Moisture Indicator Values", which was based on an extensive review of the literature, for understorey species in *Pinus contorta* forests:

1 = xeric
2 = xero-mesic
2.5 = submesic
3 = mesic
4 = hygro-mesic
5 = hygric.

This scheme is also used in the discussion to follow.

3.4.1 Athabasca

The understorey vegetation at Athabasca reflects its low moisture availability. The dominant and most common species at Athabasca, including *Arctostaphylos uva-ursi*, *Shepherdia canadensis*, *Solidago* sp., and *Senecio streptanthifolius*, were xerophytic or xero-mesophytic. A few sub-mesophytic and mesophytic species such as *Linnaea borealis* and *Pyrola chlorantha* were also found; however, no hygro-mesophytic or hygrophytic species were present at Athabasca.

The high degree of species dominance seen at Athabasca is reflected in the dominance indices (Table 3-5) and in the shape of its species structure curve (Figure 3-1), showing the pre-eminence of the xerophytic dwarf shrub *Arctostaphylos uva-ursi*. The large increase in understorey cover between 1967 and 1989 resulted in a decreased dominance index and increased species diversity index. As the bulk of this increase in cover was due to growth in the covers of six species (including *A. uva-ursi*, *S. canadensis*, *Elymus innovatus*, and *L. borealis*), these species formed a distinct grouping in the dominance hierarchy.

Cover was significantly higher in 1989 in all understorey growth-forms including shrubs, dwarf shrubs, forbs, graminoids, and mosses. However, the factors affecting these changes appear to vary among growth-forms. The significant difference in summer precipitation between the two study years (see Chapter 1, Figure 1-9) could itself affect the growth and cover of opportunistic and fast-growing species in the forb and graminoid growth-forms. For example, the large increase in *Elymus innovatus* cover could be due to a response to the wetter conditions in 1989. The large decline in cover and frequency of *Carex* species, which dominated the graminoid growth-form in 1967, and a similar decline in *Pyrola chlorantha* frequency, may reflect their inabilities to compete with more opportunistic species in the presence of abundant moisture in 1989, or a more general inability to compete with the ever-increasing shrub and dwarf shrub growth-forms. Mueggler's (1992) permanent plot study in mountain grassland ecosystems indicated that 200 percent differences in biomass production can be observed between "good" and "poor" growth years and that increased yields of one species often lead to decreased yields of another.

Differing precipitation amounts between study years alone cannot account for the large increase in the covers of shrub and dwarf shrubs at Athabasca. These slower-growing, long-lived woody perennials such as *S. canadensis*, *A. uva-ursi*, *L. borealis*, *Juniperus communis*, and *Rosa acicularis* simply could not respond so quickly in terms of growth to increased moisture availability in one or two years.

The presence of fire scars on many tree trunks in the site was observed by Hnatiuk in 1967 and were still visible in 1989. This confirms that a surface fire occurred prior to 1967 which burned the understorey vegetation without killing the larger trees. Thus, the increased cover of dwarf shrub and shrub species in 1989 could be a simple reflection of an additional 22 years of recovery after fire disturbance.

The role of selective grazing by elk and deer could also be a factor in changing species cover and frequency. When Highway 93 was rerouted to the east side of the Athabasca River through this forest stand in the early 1960s, the 10 m right of way on each side of the road was revegetated with introduced rangeland species which attracted large numbers of ungulates which preferred these species for grazing. The close proximity of the Athabasca permanent reference stand to the highway resulted in visible impact of ungulate trampling in 1967 (Hnatiuk 1969) and was the probable cause of *Taraxacum officinale* and *Trifolium repens* introduction (Table 3-4). The heavy selective grazing of the introduced species on the right-of-way allowed native species to return to dominance (personal communication with G.H. La Roi 1993). This may be the cause of reduced ungulate grazing in the area and an apparent lower trampling impact in the site in 1989 relative to 1967; however, more study on the grazing habits and changes in population size of these ungulates would be needed to make such a determination.

Examination of the interspecies correlation matrices (Tables 3-7 and 3-8) and the quadrat classification allowed two relatively separate plant communities to be identified at Athabasca. One community, found on the old river island densely stocked with pine, was characterized by high moss cover and relatively abundant *Shepherdia canadensis*, *Linnaea borealis*, *Orthilia secunda*, *Pyrola chlorantha*, and terrestrial lichens. These species, with the exception of lichens, are xero-mesophytic to mesophytic in their moisture preferences (La Roi and Hnatiuk 1980). The classification of quadrats indicated that this community was absent in 1967. While the species associations describing this community existed in 1967 (Table 3-7), the species cover was too low and the quadrats were thus classified in the "low cover" class which dominated Athabasca in 1967 (Figure 3-13). Hnatiuk (1969) suggested that fire frequency was higher on the old river island (see Chapter 2) and thus this community would be subject to more frequent disturbance. In the absence of fire in the 22 years between 1967 and 1989, *S. canadensis* and *L. borealis* were able to spread and increase in cover. The resulting quadrat class transition, occurred particularly on the old river island where pine density was highest.

The second plant community shown by species correlations and quadrat classification was found in the surrounding area where pine density was lower and the soil coarser. This community was made up of more xerophytic species such as *A. uva-ursi*, *Achillea millefolium*, *Solidago* sp., *Senecio streptanthifolius*, and *Viola adunca*. The quadrat classification did not indicate the presence of this community until 1989 because of the lack of abundant *A. uva-ursi* cover in 1967 as it recovered from probable fire disturbance.

These correlations of understorey communities with mature *Pinus contorta* tree density could result from modification of the understorey environment by the pine canopy making it more favourable to species adapted to less xeric conditions. Shade cast by the trees could reduce soil temperature and evaporation, thereby creating more moist conditions (Whipple and Dix 1979). However, the high pine density itself likely reflects the favourable establishment conditions on the old river island for *Pinus contorta* following the stand-initiating fire (Chapter 2)(Hnatiuk 1969). The fine-textured soil on the island was significantly different from coarse, gravelly soil in the rest of the stand (Hnatiuk 1969) and this likely permitted higher soil moisture levels as well. The poor soil conditions in the gravelly area of the stand restricted the degree of pine establishment as well as not permitting the development of as rich an understorey. Thus, it seems more likely that both the tree and understorey species were responding to local site conditions, instead of the tree canopy being the dominant factor modifying the understorey environment.

In La Roi and Hnatiuk's (1980) vegetation classification system of *Pinus contorta* forests, the Athabasca site fits well into the PINUS CONTORTA / SHEPHERDIA CANADENSIS / ARCTOSTAPHYLOS UVA-URSI community type. This is the most xerophytic of the five community types they described, and is most common in the relatively warm, dry bottoms of the larger river valleys in the montane zone. In the absence of fire, low-elevation stands such as Athabasca eventually develop into climax PSEUDOTSUGA MENZIESII / ELYMUS INNOVATUS forests. However, the evidence of this occurring is described as "fragmentary" and the process as "very slow" (La Roi and Hnatiuk 1980). The Athabasca stand provides an example of this very slow succession as no evidence of *P. menziesii* recruitment was seen (see Chapter 2) and the predicted *A. uva-ursi* decline has not begun. Possible positive evidence of this succession is the increase in the understorey ranking of *Elymus innovatus* from sixth in 1967 to second in 1989.

Using Holland and Coen's (1982) "vegetation type" classification, the Athabasca site can designated in 1989 as belonging to the C3: PINUS CONTORTA / JUNIPERUS COMMUNIS / ARCTOSTAPHYLOS UVA-URSI vegetation type. The cover of shrubs and dwarf shrubs in 1967 was too low to meet the definition of the C3 class. However, the disturbance caused by the pre-1967 surface fire was not taken into account by the classification system. The C3 vegetation type is considered to be advanced to mature successionally, even in stands as young as Athabasca (83 years in 1989) (Holland and Coen 1982).

3.4.2 Sunwapta

Of the four permanent plots, species richness was highest at the mesic Sunwapta site (Table 3-5). This was probably due to the moderate levels of moisture available at this site allowing species from a wider range of moisture adaptations to grow. Mesophytic and submesophytic species such as *Linnaea borealis*, *Aster conspicuus*, *Antennaria howellii*, *Orthilia secunda*, and *Melampyrum lineare* were abundant and some hygro-mesophytic species such as *Cornus canadensis* and *Goodyera oblongifolia* were common, while at the same time most of the xerophytic and xero-mesophytic species found at Athabasca were also present.

Unlike Athabasca, no one species dominated the understorey, and covers of even the most common vascular plant species were below 5%. The only exception was the nitrogen-fixing shrub *Shepherdia canadensis* which had covers of over 9% in both study years. The higher moisture availability combined with better soil nutrient conditions are the likely reasons for the better-developed shrub stratum at this site as compared to Athabasca. Although Sunwapta was flat overall with a relatively low density of tall trees, microtopographical relief such as small hummocks and depressions, and alternating shade and exposure due to patches of *Shepherdia*, created many microhabitats which allowed for the development of a rich herb stratum. It appears that soil moisture was slightly higher in the eastern part of the plot as covers of mesophytic species such as *Salix* spp., *Cornus canadensis*, *Vaccinium vitis-idaea*, and *Pleurozium schreberi* were higher in this area.

The cover of vascular understorey plants doubled between 1967 and 1989 and the cover of mosses increased sixfold (Tables 3-5 and 3-6). Fire cannot be invoked as a probable factor as it was at Athabasca since no fire scars were seen. In addition, the cover of the relatively long-lived *S. canadensis* remained virtually unchanged, indicating that this shrub was already well established in 1967. However, while *S. canadensis* cover did not change, its dispersion throughout the site changed significantly between 1967 and 1989. The quadrat classification shows that in 1967 *Shepherdia* was clumped into areas of high cover with intervening areas of low cover, whereas by 1989 its cover was more evenly distributed through the site.

The fact that 1989 was a wetter year than 1967 may explain the increased forb and graminoid cover, and the apparent increase in *Arctostaphylos uva-ursi*, *Juniperus communis*, and *Vaccinium caespitosum* may be partially accounted for through observer differences in cover estimations. However, these reasons cannot explain cover increases in *Rosa acicularis*, *Linnaea borealis*, and *Vaccinium vitis-idaea*. Natural thinning of the tree stratum since 1967, with a consequent increase in light reaching the ground, could be one factor.

The bryoid stratum was better developed and had a greater species richness at Sunwapta than Athabasca (note that the minor bryoid species were not identified or inventoried), reflecting the wetter conditions at this mesic-class site. Precipitation differences alone cannot account for the huge increase in moss cover between 1967 and 1989. La Roi (personal communication), after a 10 year boreal ecosystem study at Hondo, Alberta, found no evidence of dramatic changes in feather-moss cover estimates following wetting, which tends to negate the suggestion that cover estimates were affected by the moisture content of the feather mosses. However, in the same study, similar large increases in year-to-year feather moss covers were seen, suggesting that such cover changes are part of the longer-term temporal dynamics of mountain and boreal understorey communities.

The higher covers of mosses and graminoids seen in 1989 may be providing increased competition and, hence, causing reductions in the frequencies of many xerophytic species such as *Antennaria howellii*, *A. rosea*, *Achillea millefolium*, *Senecio streptanthifolius*, and *Solidago* spp.. At the same time frequency increases were seen in submesophytic to hygro-mesophytic species such as *Goodyera oblongifolia*, *Habenaria obtusata*, and *Lycopodium complanatum*. These frequency changes are significant because species frequency is more stable than species cover when year-to-year weather differences occur. Thus, these frequency dynamics between 1967 and 1989 and the apparent long-term changes in moss cover may indicate a real successional shift in the composition of the understorey.

Field observations and the interspecific correlation coefficients (Tables 3-9 and 3-10) indicate that the different feather-moss species tended to grow together in small patches and that vascular species associated with these patches included *Chimaphila umbellata*, *Linnaea borealis*, *Vaccinium caespitosum* and *V. vitis-idaea*, which are all submesophytic or mesophytic. This species association, in turn, grew in the patches of the abundant immature *Pinus contorta* that were unique to the Sunwapta site in both study years. In drier open areas away from these immature pine patches and *S. canadensis* cover, lichens, *Melampyrum lineare*, and the drought-tolerant moss *Dicranum polysetum* dominated instead. No clear pattern of understorey species relationships could be determined, echoing Hnatiuk's (1969) difficulty with the 1967 inventory. His suggestion that the 5 × 5 m quadrat size was too large to detect patterns in understorey species associations at Sunwapta is consistent with these results (Hnatiuk 1969). The pattern of patches of shrub cover and dry open areas observed by both Hnatiuk and myself occurred at a scale smaller than the 5 × 5 m quadrat grid.

No correlations were found between understorey species cover and mature tree density at Sunwapta. This absence of correlations may be due to the low mature tree density and cover seen at Sunwapta (Table 2-1 and Figure 2-12). It thus appears that soil moisture and shade from shrubs were the dominant factors affecting understorey species distribution and the distribution of *Pinus contorta* establishment.

The closest socion of La Roi and Hnatiuk (1980) describing the Sunwapta vegetation community is the PINUS CONTORTA / SHEPHERDIA CANADENSIS / ELYMUS INNOVATUS community type. However, *Linnaea borealis* is dominant in the herb-dwarf shrub stratum at Sunwapta, although *Elymus innovatus* was the dominant herb in both study years.

The Sunwapta community can be classified as a C19: PINUS CONTORTA / SHEPHERDIA CANADENSIS / LINNAEA BOREALIS vegetation type according to Holland and Coen 1982. This type is considered to be successional to C31 or C37 vegetation types which are spruce/fir dominated, with *Hylocomium splendens* important in the understorey (Holland and Coen 1982). However, as was seen in Chapter 2, there is no evidence of *Pinus contorta* being replaced by *Picea* or *Abies*, and *P. contorta* establishment is predominant. Furthermore, *Hylocomium splendens* remained a relatively unimportant component of the understorey. It appears, therefore, that the Sunwapta stand is following a different successional course than seen in other C19 stands. The understorey at this stand may have reached some kind of equilibrium just as the overstorey stratum may represent a *Pinus contorta* climax (Chapter 2), but this is difficult to determine based on only a 22 year interval.

3.4.3 Whirlpool

The "Moist Class" Whirlpool site was dominated by feather mosses in both study years. The vascular understorey, despite its relatively low cover, had high species diversity (Table 3-5). The moist conditions and the separate habitats created by the two river terraces are probably contributing factors to this high vascular diversity which was present even in 1967 when total vascular species cover was less than 5 percent. The upper terrace was slightly drier than the lower terrace and thus had lower covers of mesophytic and hygro-mesophytic species such as *Hylocomium splendens*, *Cornus canadensis*, and *Arnica cordifolia*, while having higher covers of more xerophytic species such as *Pleurozium schreberi*, *Arctostaphylos uva-ursi*, and *Vaccinium caespitosum*.

The abundant moisture and the lack of a well developed shrub stratum created the right conditions for *C. canadensis*, a hygro-mesophytic species, to dominate the dwarf shrub stratum. *Cornus*, which was correlated with the dominant feather moss *H. splendens*, was able to flourish in the thick moss carpets, which cover large areas of the site, where other dwarf shrub and herb species were overwhelmed by the quickly growing feather moss.

The classification of quadrats in 1967 and 1989 (Tables 3-20 and 3-21, Figure 3-15) did not show very meaningful transitions between understorey communities over time due to the large increase in vascular cover from 5% in 1967 to 26% in 1989 (Table 3-5). In 1967 the vast majority of quadrats (93%) fell into a single class (Class 1) representing quadrats with low vascular cover, but the number declined to 35% in 1989 as cover of all the major vascular understorey species increased (Figure 3-15). Most of the remaining low-cover quadrats were on the lower terrace or in an upper terrace depression. This was likely because in these quadrats tree canopy cover was high (Figure 2-12) and a deep feather moss carpet dominated by *Hylocomium splendens* provided intense competition with most vascular species. However, *Cornus canadensis* was able to grow and thrive in feather moss dominated areas as it came to dominate the vascular understorey in the western part of the lower terrace in 1989, despite high *H. splendens* cover in the same area. On the drier upper terrace, *Arctostaphylos uva-ursi* and *Shepherdia canadensis* cover increased between 1967 and 1989. Their 1989 distributions indicate that these species are either not able to compete with the *H. splendens* carpet or are not adapted to conditions of high tree cover. Declines in the frequency of *Pyrola chlorantha* and *Calypso bulbosa* indicate that these species, in turn, were not able to compete with the higher shrub and dwarf shrub cover on the upper terrace.

The most stable quadrat class represented quadrats dominated by *Juniperus communis* (Tables 3-20 and 3-21) reflecting the high longevity of this species (Table 3-24). The distribution of these quadrats along the ridge separating the two terraces where tree density and canopy cover were lower (Figure 2-12 and 2-15) may reflect shade-intolerance of *J. communis*. Its increase in cover may simply reflect an additional 22-years of growth or be due to the decline in *P. contorta* density and cover.

The cause of the huge increase in vascular species cover between 1967 and 1989 is not clear. No physical evidence for a surface fire prior to 1967, as occurred at Athabasca, was seen at Whirlpool. As at Athabasca, the bulk of the cover increase was due to growth of longer-lived species such as *S. canadensis*, *Juniperus communis*, *A. uva-ursi*, *Vaccinium caespitosum*, and *Linnaea borealis*. While 1989 was much wetter than 1967, these species are relatively slow-growing and would not be able to respond so quickly to such year to year changes. However, it may be that these species, found mainly on the drier upper terrace, responded to *Pinus contorta* mortality resulting in a large density reduction (Table 2-1) and a corresponding reduction in tree canopy cover. The creation of gaps in the canopy by tree mortality could result in gap dynamic processes occurring in the understorey; however, the quadrat size used in this study was probably too large to demonstrate this process of gap dynamics if it indeed was occurring at Whirlpool.

Picea mariana density was positively correlated with the hygro-mesophytic feather mosses and *Cornus canadensis*, while being negatively correlated with the more xerophytic and xero-mesophytic species such as *S. canadensis*, *A. uva-ursi*, and *Achillea millefolium* (Tables 3-11 and 3-12). This division into species groupings is closely related to the vegetation differences seen on the two terraces discussed earlier. As was discussed in Chapter 2, quadrats with high *P. mariana* density also had high canopy cover. Therefore, there may be a canopy influence on the distribution of understorey species with shade-intolerant species "avoiding" areas of high *P. mariana* density. However, the hygro-mesophytic species grouping was also found in quadrats that were not dominated by *Picea mariana* until 1989. Thus, as at Athabasca, these correlations of tree density and understorey species may not so much reflect an overstorey modification of the understorey as the fact that soil moisture differences between the two terraces have been influencing the development and composition of both strata.

The Whirlpool community is not exactly described by any of La Roi and Hnatiuk's (1980) "community types". Their community types best describing the vegetation at Whirlpool are PINUS CONTORTA / ALNUS CRISPA / LINNAEA BOREALIS and PINUS CONTORTA / LEDUM GROENLANDICUM / VACCINIUM SCOPARIUM. Feather moss carpets are common in both community types, and *Picea mariana*, important at Whirlpool, is common in the second type. The *Ledum/Vaccinium* type often has a weakly developed vascular understorey, as was also seen in terms of cover at Whirlpool. However, these community types do not properly describe the shrub stratum at Whirlpool which was dominated by *Shepherdia canadensis*, whereas *A. crispa* and *L. groenlandicum*, though present, were only minor components of the shrub stratum.

Using Holland and Coen's (1982) "vegetation type" classification system the Whirlpool site would be designated in both years as C11: PINUS CONTORTA-PICEA SPP. / HYLOCOMIUM SPLENDENS. The cover of *S. canadensis* is just above the upper limit allowed by the type definition but the lack of extensive *Alnus crispa* at the site prevents this site being classified in any other feather moss-dominated vegetation type.

Successionally, the C11 vegetation type is described as intermediate to advanced in forests between 125 and 200 years old (Holland and Coen 1982) and likely seral to the C13: PICEA ENGELMANNII-ABIES LASIOCARPA / HYLOCOMIUM SPLENDENS vegetation type. While the age of C11 stands is consistent with the 151 y age of Whirlpool, there is little evidence of *Picea engelmannii* or *Abies lasiocarpa* becoming canopy dominants. The feather moss carpet will likely continue to dominate the lower terrace understorey in the future. However, if trends observed between 1967 and 1989 continue, growth in shrub and dwarf shrub species could result in the drier upper terrace becoming more similar to the *Shepherdia canadensis* dominated understorey community seen at Sunwapta.

3.4.4 Hector

The subalpine Hector site was placed with the Whirlpool site into Hnatiuk's "Moist Class". However, the structure of its understorey was significantly different. *Menziesia ferruginea* completely dominated the understorey, forming a closed shrub canopy not seen at any of the other sites. This shaded the forest floor to the extent that the diversity and cover of the herb and dwarf shrub strata were quite low. The closed shrub stratum also resulted in an almost complete absence of the graminoid growth-form. The site was also unique in that species frequency, cover, and species structure of the vascular understorey changed little between 1967 and 1989. The small decline in *Menziesia* cover is probably due to estimation differences between the researchers as it is difficult to estimate the two-dimensional cover of a three-dimensional shrub stratum. This hypothesis is corroborated by comparisons with point cover estimates which indicated a relative underestimation of *Menziesia* in 1989 (Table 3-2).

The large increase in moss cover at Hector between 1967 and 1989, while vascular cover remained stable, may again be partially related to the wet growing season of 1989 and the dry growing season of 1967. As at Sunwapta, the dominant moss, *Pleurozium schreberi*, may have been difficult to see under the abnormally dry conditions of 1967, while the moss was lush, green and highly visible in the abnormally wet year of 1989 (see Figure 1-10). However, the six-fold increase of moss cover seen at Hector is far greater than what could be attributed to moisture changes or to hygroscopic shrinking or swelling in one or two growing seasons. These changes provide additional evidence that the long-term dynamics of the vascular and bryoid components of the understorey can vary greatly.

Species correlations and quadrat classification identified two species groupings at

Hector. The dominant grouping was made up of the hygro-mesophytic species *M. ferruginea*, *Ledum groenlandicum*, and *Pleurozium schreberi* and thus probably occurred where moisture was relatively abundant. While *Menziesia* was widespread in the site, this grouping was strongest in the northwest and weakest in the southeast (Figures 3-11, 3-12, and 3-16, Tables 3-13 and 3-14) and corresponded to the quadrats where *Picea engelmannii* and *Abies lasiocarpa* density increases were greatest and where *Pinus contorta* density was not high (Table 3-13, 3-14, and Figure 2-14).

The second grouping was composed of the xero-mesophytic and submesophytic species *Shepherdia canadensis*, *Linnaea borealis*, and *Stereocaulon* spp. and therefore likely occurred in drier areas of the site. This grouping was strongest in the southeast near the edge of the ravine where *Pinus contorta* density was highest (Figure 3-16 and 2-14). Distance from the fire margin and the density of *Pinus contorta* appear to influence the location of species associations much more than elevation.

Since *P. contorta* density was negatively correlated with the first species grouping and positively correlated with the second, it appears that the tree canopy is influencing the composition of the understorey at Hector. At Athabasca and Whirlpool the possibility that both overstorey and understorey were responding to soil moisture could not be ruled out. However, at Hector there does not appear to be a topographical explanation for the distribution of understorey species as the elevation gradient runs perpendicularly to the vegetation gradient. It appears that where *P. contorta* density was high, soil moisture was reduced to the extent that favoured xero- and mesophytic species over hygro-mesophytic species.

The Hector community in both study years is well described by La Roi and Hnatiuk's (1980) P. CONTORTA / MENZIESIA FERRUGINEA / VACCINIUM SCOPARIUM "community type". This community type occurs where precipitation is high, snow is deep, and fire frequency is relatively low (La Roi and Hnatiuk 1980).

The vegetation community at Hector in both 1967 and 1989 would be classified as a C20: PINUS CONTORTA / MENZIESIA FERRUGINEA / VACCINIUM SCOPARIUM vegetation type according to Holland and Coen (1982). This vegetation type is considered to be seral to the C14 type where the tree canopy is dominated by *Picea engelmannii* and *Abies* *lasiocarpa* instead of *Pinus contorta*. As was seen in the previous chapter, this succession is taking place and, if no major disturbance occurs, the Hector site will eventually become a C14: PICEA ENGELMANNII-ABIES LASIOCARPA/MENZIESIA FERRUGINEA/VACCINIUM SCOPARIUM community (Holland and Coen 1982). Thus, in the case of the entire forest community at Hector, its understorey community has reached equilibrium or "climax" status while successional dynamics are still very apparent in the structure of its tree stratum.

3.4.5 Species Temporal Stability

Temporal stability was high for almost all the shrub and dwarf shrub species inventoried at the four sites (Table 3-23). This is not surprising in that these growth-forms are relatively long-lived and slow-growing. Forbs and graminoids, especially if they were annuals, had lower temporal stability (Table 3-23) reflecting their shorter life-spans. *Cornus canadensis*, which was an exception to this rule, has a creeping rootstock and can thus form more long-lived colonies; indeed, it may be viewed as an "underground shrub" since most other *Cornus* species are either shrubs or small trees. Another exception, *Aster ciliolatus*, is rhizomatous, giving it greater temporal stability.

Temporal stability may be affected by species competition. *Linnaea borealis* had high stability in sites with low species richness, and low stability in sites with high species richness, indicating that in more competitive environments it becomes more opportunistic. An apparent relationship exists between *Fragaria virginiana* stability and site moisture regime with the stability of this species increasing with increasing moisture availability. However, this correlation is likely related to this xero-mesophytic species having few suitable locations to grow in the moist sites, while having abundant favourable locations in the xeric site.

3.4.6 Site Similarity

The Sunwapta and Whirlpool vascular understorey communities showed the greatest similarity in both study years with respect to the qualitative and quantitative similarity measures. These sites both had relatively high vascular species richness and were not dominated by a single species as much as the understorey communities at Athabasca (*Arctostaphylos uva-ursi*) and Hector (*Menziesia ferruginea*) were. The differing dominant species at Athabasca and Hector, and the generally different species structures of these two sites, were due to completely different soil moisture regimes and resulted in their having the highest dissimilarity as measured by both qualitative and quantitative measures.

The increases in quantitative similarity in site pairs involving Athabasca and Whirlpool were likely because the largest increases in understorey vascular species cover also occurred at these two sites. The differences in total cover between the sites declined dramatically over the interval between 1967 and 1989. A ground fire occurred at Athabasca prior to 1967 which destroyed its understorey strata. Thus, the large increases in understorey cover and similarity of Athabasca to other sites, are probably due to its recovery from disturbance. The equally large cover increase in Whirlpool's understorey resulted in correspondingly large increases in similarity to the other sites. However, the cause of the cover increase was not as clear as at Athabasca although thinning of the Whirlpool's tree canopy may have been a factor.

When similarity indices were calculated between the 1967 and 1989 understorey communities at each of the sites, the Sørenson measures for Athabasca and Whirlpool were low, giving a further indication of the large changes at these sites over time. Sunwapta and Hector, both from higher elevations, changed much less quantitatively (see Table 3-6 Sørenson index). This may be an indication that community dynamics occurs more slowly at higher elevations where the growing season is cooler and shorter. However, the better-developed shrub strata at the two higher-elevation sites provide evidence that perhaps understorey succession at these sites occurred faster, allowing them to reach equilibrium or climax earlier than at the two Montane sites. Because of the complicating factors of the ground fire disturbance at Athabasca and the differences in study-year precipitation, this dilemma cannot be resolved until future investigations of the vegetation indicate whether these apparent trends have continued.

3.4.7 Conclusions

The understorey communities at all four sites did not show significant changes in species composition between 1967 and 1989 despite large changes (mostly increases) in species cover. Therefore, the "community type" (La Roi and Hnatiuk 1980) and "vegetation type" (Holland and Coen 1982) classifications of the four stands did not change over the study interval. This does not mean that the changes seen in the understorey communities were not significant. The above classification systems were developed to describe the major vegetation communities seen in the two National Parks and therefore do not include some successional communities that are infrequent or rare in the parks (personal communication with P. Achuff). In addition, the range of variation covered by the classification "types" is greater than any foreseeable future changes in the four understorey communities based on understorey dynamics between 1967 and 1989.

Despite the differences in moisture availability between the two study years, it is still possible to conclude that (1) moisture availability was the most significant factor affecting the distribution of understorey species, and (2) that it was also the most significant factor which separated the four *Pinus contorta* dominated communities. The xeric Athabasca site was dominated by xerophytic and xero-mesophytic species, while the moist Whirlpool and Hector sites were dominated by hygro-mesophytic species. This conclusion demonstrates that Hnatiuk's classification of the *Pinus contorta* communities (Hnatiuk 1969) does follow a moisture gradient as he claimed.

Local variations in soil moisture conditions within a stand were probably just as important in controlling species distribution as overstorey tree density distribution. While correlations were found between tree density and understorey species distributions, at Athabasca and Whirlpool these correlations were probably due to the tree and understorey species both responding to local soil moisture conditions. Only at Hector did tree density and cover seem to exert more control over the distribution of understorey species.

Thus, the relative importance of factors influencing the temporal dynamics of structural changes seen in the understorey communities of these *P. contorta* forest communities varied from site to site. The relatively recent occurrence of a ground fire at Athabasca provided a major dynamic influence not seen at the other sites. The particularly high degree of mortality in the canopy dominants at Whirlpool probably created the conditions allowing for its large increase in vascular species cover. The greater temporal stability of the understorey communities at Sunwapta and Hector may be the related to their higher elevations, or to more rapid succession and stabilization before 1967.

Changes over time in the composition and structure of the tree strata at Athabasca, Sunwapta, and Hector did not appear to exert as much control over, or be correlated with, changes in the understorey strata. While understorey changes at Whirlpool did correspond to a decline in mature tree density, the evidence for a cause and effect relationship remains circumstantial. The understorey communities at these sites were obviously influenced by the tree strata as a whole because of the shade and the moderation of the temperature, wind, and humidity. However, in this study, clear evidence of a direct relationship between overstorey and understorey structures in space or time could not be found. In making this conclusion, it has to be realized that the scale of the interaction pattern between the overstorey and the understorey strata may have been smaller than the 25 m^2 quadrats (See Chapter 4).

3.5 REFERENCES

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CHAPTER 4. CONCLUSION

The focus in chapter 2 of this thesis was on the structure and successional dynamics of the tree stratum at the four sites; in chapter 3 it was on the composition, distribution and temporal dynamics of the understorey. Although these strata were described and discussed in separate chapters, they are, of course, related components of an interdependent forest community.

This concluding chapter begins with a summary of the factors that appear to strongly influence the spatial and temporal dynamics of both overstorey and understorey strata, and in Rocky Mountain pine forests in general, and what relationships exist between these two strata at the four sites. This is followed by an assessment of the ability of permanent plots, configured as in this study, to document both stand and local dynamics in *Pinus contorta* dominated communities. Finally some conclusions are made on the value of these permanent reference stands as ecological monitoring stations in detecting and documenting temporal changes in tree populations and physical environmental components of mountain forest ecosystems in Banff and Jasper National Parks.

4.1 Summary of Interpretation of Site Dynamics

4.1.1 Athabasca

Tree density was the dominant factor affecting the dynamics of the tree stratum in this Montane xerophytic forest between 1967 and 1989. Higher mortality occurred among the densely packed trees on the river island reducing pine aggregation (i.e., clumping of the population). However, this loss in tree basal area was partly compensated for by incremental growth of the survivors. Soil moisture conditions appear to be xeric enough to prevent the establishment of spruce and fir. The equally notable absence of *Pseudotsuga menziesii* establishment, on the other hand, may be more due to poor nutrient availability at the site because this species is even more xerophytic than

Pinus contorta.

The structure and composition of Athabasca's understorey was also strongly influenced by the xeric conditions. The dominance of xerophytic species, and the lack of hygro-mesophytic species, tend to confirm that soil moisture was a major limiting factor at Athabasca. The spatial segregation of the mesophytic and xerophytic plant communities likely reflected spatial variations in soil moisture availability for plant use, but I have no soil moisture data to test this inference.

The major factors affecting understorey dynamics appear to be (1) the occurrence of a ground fire prior to 1967, and (2) trampling and possibly grazing by ungulates in the mid to late 1960's. The large increases in shrub and dwarf shrub cover between 1967 and 1989 indicate a process of recovery from these disturbances. The significant growth and spread of *Arctostaphylos uva-ursi* mats and the large increase in *Shepherdia canadensis* shrub cover resulted in a structural shift in the understorey toward increased species dominance (i.e., decreased species equitability). In contrast, a large difference in summer precipitation was probably responsible for the huge increase in graminoid (i.e., *Elymus innovatus*) cover between the two study years. Grasses seem to be more opportunistic than the other growth-forms.

The increasing cover of the nitrogen-fixing shrub *Shepherdia canadensis* at Athabasca may in the future affect the species composition of the site. Other studies have shown that nitrogen fixation by *S. canadensis* can have a significant effect on the soil nutrient balance of low-nutrient adapted pine systems (Hendrickson and Burgess 1989). Thus, continuing increases in *S. canadensis* cover at Athabasca may, in the long-term, result in increases in soil nitrogen and the establishment of new species currently excluded due to low nitrogen availability.

Athabasca was unique among the four sites in that there was clear evidence of major disturbance during the development of the present stand (i.e., surface fire). Because the surface fire(s) had a much larger impact on the understorey than on the trees, the "successional age" of the understorey was much younger than that of the overstorey in both study years, and especially so in 1967. Therefore the dynamics of self-thinning of small trees on the old river islands reflects ongoing successional development of the stand, whereas the large increase in shrub and dwarf shrub cover probably reflects recovery from a relatively recent disturbance. Thus, at the Athabasca site, changes in the tree stratum were not related to understorey dynamics as the selective fire disturbance had put successional development of these two strata out of synchrony. Tande (1977) found many pine stands in the Jasper townsite area with evidence of repeated surface fires.

4.1.2 Sunwapta

Ungulates also had an impact on community dynamics in the Lower Subalpine mesophytic forest at Sunwapta, but whereas at Athabasca it was on understorey species, at Sunwapta it was on tree saplings. The girdling of pine saplings by elk has prevented the abundant pine establishment from reaching the tree canopy between 1967 and 1989. With continued mortality among the large mature trees, this resulted in decreasing tree density in a site where tree density was already quite low. Moisture may also be a factor in Sunwapta overstorey dynamics; as at Athabasca, moisture levels may be too low to permit establishment of spruce or fir despite the presence of nearby seed trees.

As at Athabasca, the structure and composition of the understorey were influenced by spatial variations in moisture availability such that both xerophytic and hygro-mesophytic species were present. As a result, Sunwapta had the highest species richness of the four sites. Spatial segregation of xerophytic and hygro-mesophytic species groups, however, was less pronounced than at Athabasca.

No single factor probably accounts for the understorey dynamics between 1967 and 1989 at Sunwapta. The changing dispersion of the shrub dominant *Shepherdia canadensis*, and the increasing covers of *Juniperus communis* and other shrubs, dwarf shrubs, forbs and mosses may be products of ongoing successional dynamics in the understorey. These dynamics may have been influenced by the decreasing density of the tree stratum and probable decreases in canopy shading. The fact that no direct correlations between overstorey and understorey dynamics could be found is probably due to the already low tree density in 1967 and the widely dispersed tree mortality.

4.1.3 Whirlpool

Moisture availability appears to be the dominant factor affecting the structure and dynamics of the tree stratum in the Montane moist forest at Whirlpool. Whirlpool was unique among the four sites in that it had a major topographical discontinuity, i.e., two river terraces. The differing moisture regimes of the two terraces resulted in differing species compositions and differing temporal dynamics between the two terraces. The wetter conditions on the lower terrace allowed the hygro-mesophytic tree species *Picea mariana* to become an increasingly important part of its tree stratum; whereas this species was much rarer on the drier upper terrace.

The large decline in *Pinus contorta* density between 1967 and 1989 on the lower terrace, where it had been high, may have been caused by several factors including increasing competition with *Picea mariana*, self-thinning, and the occurrence of *Arceuthobium americanum* (dwarf-mistletoe) infestation. The reasons for the lack of *Pinus contorta* recruitment into the canopy stratum differed between the two terraces. On the lower terrace, immature *Pinus contorta* was virtually absent due to the species' inability to become established in the thick feather-moss carpet which dominated the understorey there. Immature *Pinus contorta* was present, but scarcely growing, on the upper terrace. Its growth was likely restricted by lack of light due to the well developed tree canopy.

Moisture availability also appeared to be the dominant factor affecting the composition and structure of the understorey, with hygrophytic species dominating the lower terrace and mesophytic and xerophytic species dominating the upper terrace.

The huge increase in understorey vascular species cover between 1967 and 1989 occurred on both terraces, but was most pronounced on the drier upper terrace. This stand is the oldest of the four stands surveyed and no evidence of major past surface disturbance was seen. Thus, it is difficult to explain the degree of understorey dynamics at Whirlpool. One hypothesis is that the increase in cover may be related to decreasing tree density. Although *Pinus contorta* density declined even more on the lower terrace, the thick feather moss carpet and competition from *Picea mariana* hindered growth of the vascular species there. Thus, while the decline in tree density did not free up enough resources, such as light, to permit growth of shade-intolerant immature *Pinus contorta*, it did allow for more growth of shade-tolerant understorey vascular species.

The differences in species composition and successional dynamics seen on the two terraces at Whirlpool strongly suggest that the Whirlpool site represents two distinct forest communities. The lower, wetter terrace is a *P. contorta-Picea mariana/Cornus canadensis/Hylocomium splendens* community while the upper, drier terrace is a *Pinus contorta/Shepherdia canadensis/Pleurozium schreberi* community. The distributions of species with relatively low covers, such as *Vaccinium caespitosum* (upper terrace), *Linnaea borealis* (upper terrace), and *Ptilium crista-castrensis* (lower terrace) further supports this separation of Whirlpool into two communities. Vascular species richness at Whirlpool was less than at Sunwapta, despite the wide moisture range spanned by the Whirlpool site, due to the dominance of feather mosses on both terraces.

4.1.4 Hector

The major "factor" affecting the structure and dynamics of the tree stratum at Hector seems to be the fire history of the stand and the location of the fire margin created by the stand-initiating fire. This fire margin crosses the northwest corner of the site and separated survivors of the fire, which included mature *Abies lasiocarpa* and *Picea engelmannii* trees, from the younger stand (103 y in 1989) initiated by the fire, which is now dominated by *Pinus contorta*. The fire margin has affected the dynamics of the stand in that a wave of *Picea* and *Abies* establishment has been moving uphill through the younger *Pinus contorta* stand from the seed source trees behind the fire margin.

The dense shade created by the high density of *Pinus contorta* and the thick *Menziesia ferruginea* shrub stratum was also an important factor influencing tree recruitment. Shade-intolerant *Pinus contorta* could not become established under these conditions and was thus almost absent. However, *Picea engelmannii* and *Abies lasiocarpa* are shade tolerant and were thus able to recruit and grow quickly under the pine canopy.

Pinus contorta density appeared to be the major factor influencing the distribution of the understorey species at Hector. Hygro-mesophytic species such as *Menziesia ferruginea* were found in areas with lower *P. contorta* density while more meso- and xerophytic species were associated with high pine density. The reason for this relationship is uncertain, but one hypothesis is that the pine provided too much competition for water and nutrient resources to allow growth of hygro-mesophytic species in areas where pine density was high. Tree density was highest at Hector making it difficult to compare overstorey-understorey associations at other sites under similar density conditions.

4.1.5 Rocky Mountain Pinus contorta Communities

This intensive study of the overstorey and understorey components of four different *Pinus contorta* communities has revealed a complex interaction of factors that control the community structure and dynamics of Rocky Mountain *Pinus contorta* forests. Each forest has had a unique life history.

The soil moisture regime appears to be a very important factor in the structure and composition of the understorey community. This conclusion supports the decision by Hnatiuk (1969) to classify *Pinus contorta* dominated forests on the basis of their moisture regimes. Spatial variation of moisture conditions within a stand was in many cases (but not all) the most important factor influencing the distribution of understorey species.

The soil moisture regime of a stand is also an important factor in the successional dynamics of the tree stratum because it determines what tree species can become established. Many of the drier stands like Athabasca and Sunwapta may remain dominated by *Pinus contorta* and thus be a kind of *Pinus contorta* edaphic climax forest due to the inability of *Picea* and *Abies* to become established. Such *Pinus contorta* climax stands have been described throughout the Sierra Nevada, Cascades, and Rocky Mountains (Moir 1969, Whipple and Dix 1979, Peet 1981, Despain 1983, Parker 1986, Stuart *et al.* 1989); however, there is significant disagreement on what factor is most limiting for pine recruitment in these stands. Most of the literature suggests that canopy shading is the major factor limiting pine recruitment in old, self-perpetuating pine stands (Whipple and Dix 1979; Peet 1981; Despain 1983; Parker 1989), but recently evidence has been presented indicating that competition for soil moisture was most limiting to seedling establishment in these stands (Stuart *et al.* 1989). The results of this study tend to support the latter hypothesis in that pine recruitment was significantly higher at mesic Sunwapta than xeric Athabasca despite its having higher canopy cover.

Stands where sufficient moisture is available for *Picea* and/or *Abies* establishment may, in the absence of fire, be seral to *Picea* or *Picea-Abies* forests. The succession to a *Picea mariana/P. contorta* forest in the low elevation moist Whirlpool site and the succession to a *Picea engelmannii/Abies lasiocarpa* forest in the high elevation Hector stand is consistent with findings by Cormack (1953), Beil (1966), Laidlaw (1971), and La Roi and Hnatiuk (1980).

Annual variations in precipitation may result in large annual changes in the covers and frequencies of opportunistic species such as graminoids. These species are able to respond quickly to favourable conditions and may out-compete other species for space and light resources in favourable years (Mueggler 1992). *Elymus innovatus*, because of its graminoid growth-form and abundant annual seed production, is likely an important opportunistic species in these Rocky Mountain pine forests and increases its dominance in the understorey during wet years.

Other factors such as elevation, topography, geology, site history, tree density, and ungulate populations complicate overstorey and understorey dynamics. *Abies lasiocarpa* and *Picea engelmannii* are more abundant at higher elevations in the Upper Subalpine ecoregion while *Picea mariana* is more common in hygro-mesic lower elevation Montane sites. The spread of *Picea* and *Abies* recruitment through a stand may be related to the location of fire margins and seed trees which are factors of site history. *Pinus contorta* recruitment and growth is low when feather moss cover, shrub cover, or tree density is high. Finally, the influence of large herbivores seems to vary considerably, both spatially and temporally, but is very difficult to assess.

While significant changes were seen in understorey species cover at three of the four sites, the structure and composition of the understories at all four stands was remarkably stable between the study years. Whittaker (1974, 1975) and Nieppola's (1992) findings, that the understorey vegetation composition was quite stable in mature stands where a "climax" tree species formed the canopy, are consistent with the stability seen at Athabasca and Sunwapta where pine may be the climax tree species. However, the greater understorey stability seen at Hector, where pine is clearly seral to spruce and fir, suggests that changes in the composition of the tree stratum may not be an important influence in understorey dynamics. It may be that once a mature tree canopy is formed, overstorey and understorey succession become relatively independent.

The relationship between the distributions of overstorey and understorey strata in these *Pinus contorta* forests is complex. Large changes over time in understorey cover may be related to opening or closing of the tree canopy. In this study the distribution of understorey species appeared to be more influenced by the tree stratum in stands where tree density and cover were high (i.e., Hector). In some stands, however, strong correlations between overstorey and understorey composition may be more controlled by variations in soil moisture and nutrient conditions affecting both strata than by one stratum influencing the other. It is therefore difficult to make any definite conclusions on the relationship between the tree canopy and the understorey. Bonham et al. (1986), in a study of Colorado pine and spruce/fir forests with understorey communities similar to Athabasca and Sunwapta, found that the distributions of understorey species were relatively independent of overstorey composition and dominance.

The succession to *Picea mariana/P. contorta* and *Picea engelmannii/Abies lasiocarpa* forests that appears to be occurring at the moist Whirlpool and Hector stands may provide some clues to the mechanism of succession in pine dominated stands in the Canadian Rocky Mountains. The relative old age of the mature pine canopy, and the relative youth (see Hnatiuk 1969) and increasing frequency of spruce and fir in these stands, suggests that spruce and fir did not become established until after a mature canopy had formed and that this establishment process is still occurring. These results conflict with Daubenmire and Daubenmire's (1968) conclusion that all seral species become established at once and that succession is due to differential growth rates. Their findings support individualistic models of succession (Gleason 1926; Whittaker 1967; Crawley

1986) where characteristics (e.g., growth rate) of the individual are more important to successional dynamics than overall community structures. However, results from this study tend to support the facilitation model of succession (Clements 1916; Odum 1969) in that the *P. contorta* canopies at Whirlpool and Hector may be providing the favourable conditions required for the establishment of later-successional species (i.e., spruce and fir). Whipple and Dix (1979) came to a similar conclusion in their study of pine forest succession in Colorado. Other studies have shown that spruce and fir establishment and growth is inhibited by direct sunlight even when moisture is abundant and that a closed tree canopy is required before recruitment of these species will occur (Alexander 1958; Ronco 1970a,b). While the facilitation model may more accurately describe the sequence and process of succession in these Rocky Mountain stands, this study provides no evidence to support any "organismic" aspects of this model. Instead, the importance shown in this study of stochastic events and site-specific factors on forest dynamics shows that studies of forest succession in the Rocky Mountains have to consider the level of species and the individual as well as the emergent properties of communities.

4.2 The Use of Permanent Plots

Permanent plots should be large enough to encompass the full range of natural variation exhibited by the community type in which it is placed (i.e., the "minimal area" of that community type (Mueller-Dombois & Ellenberg 1974)). While this study did not attempt to determine minimal areas, the variation seen in the structure and composition of the overstorey and understorey strata at each of the four sites suggests that the 1 hectare plots were all larger than the minimal areas for these *Pinus contorta* communities. In fact, at the Whirlpool site it appears that the plot boundaries encompassed two distinct communities; one on each of the two terraces. The common use of smaller permanent plots (e.g., 5 × 25 m in a ten year study of succession following fire (Stickney 1986)) may result in these studies documenting local (patch) dynamics and not stand dynamics.

The plot configuration was successful in documenting both stand and local dynamics. Broad, community trends such as declines in *Pinus contorta* density, increases in *Picea* and *Abies* densities, and increases in vascular and bryophyte covers were all clearly indicated by site statistics. By subdividing the permanent plot into smaller (5 × 5 m) units, it was also possible to document dynamics at a local (quadrat) scale which would not be detectable at the stand scale. For example, while site cover statistics for Sunwapta in 1967 and 1989 showed *Shepherdia canadensis* to be stable at the community scale, the quadrat statistics showed that *Shepherdia*'s distribution had changed considerably at the local scale. Another example was the overall decline in *Pinus contorta* density at Athabasca which the quadrat data showed to be largely limited to areas of high density on an old river island.

While the 5 × 5 m size of the quadrats was successful for sampling and showing the general structures of the overstorey and understorey communities, it proved to be too large to detect and assess interspecific associations among some understorey species. Patches of shrubs or moss carpets, with their associated species, were often smaller than the quadrats, resulting in more than one species association being present in a quadrat. Thus, when correlations between species were calculated, some associations may not have been elucidated. In addition, some overstorey-understorey relationships may have been missed if the scale of the interaction between the two strata was smaller than the quadrat size. Hnatiuk observed in 1967 that *Arctostaphylos uva-ursi* at Athabasca was most often found close to the trunks of the trees, where trampling by elk was minimized (Hnatiuk 1969); however, because of the spatial scale of this relationship, no significant correlation between the two species could be found.

The use of the relatively large 5 × 5 m quadrats does limit pattern analysis that can be performed on the data set. However, the use of large quadrats does have some valuable advantages in that it allows the establishment of permanent plots which encompass both local and stand dynamics. To reduce quadrat size to the extent that all spatial patterns present in the community could be studied would either greatly increase the required number of quadrats and the pressures on research resources or it would decrease the size of the permanent plot reducing its ability to document stand dynamics. If small-scale spatial patterns are of importance, then subsamples of appropriate-sized, contiguous sampling units can be taken.

This study also demonstrated the value of quantitative cover estimates over simply recording species frequencies in studying community dynamics. Some species showed large cover increases (e.g., *Arctostaphylos uva-ursi* at Athabasca and Whirlpool) and others changed significantly in distribution (e.g., *Shepherdia canadensis* at Sunwapta) without corresponding changes in their frequencies. Changes in species frequency likely provides a more conservative estimate of community dynamics than changes in species cover. However, this stability of frequency measures means that real changes in the structure and composition of vegetation communities would be better reflected by changes in species frequencies than by changes in species covers.

4.3 Permanent Reference Stands as Ecological Monitoring Stations

The protection from large-scale, human-caused disturbances that exists in Canada's National Parks provides a good environment for the establishment of a system of permanent reference stands that can act as ecological monitoring stations. In such areas, permanent reference stands, monitored at appropriate time intervals, can document natural (i.e., not human impact related) changes in the structure and composition of plant communities. This study has shown the complexity of influences that affect community dynamics over time and how many of these influences are site-specific. Because permanent reference stands factor out these site-specific variables, they provide a valuable tool for ecologists studying community dynamics.

A properly established and monitored system of ecological monitoring stations could also provide baseline data which would be useful for researchers studying systems where human impact is significant. This would then contribute to the decision making process of park managers by giving them information on the sensitivity of different forest ecosystems to human disturbance.

The plots established by Hnatiuk in this study could provide the basis for such a system of ecological monitoring stations in the Canadian Rocky Mountains. As the present four sites represent only *Pinus contorta* forests, it would, obviously, be desirable to establish sites in other forest communities as well.

The following recommendations on how such a system of monitoring stations could be established and maintained are based on the results of this study.

1) The reference stands should be established in forest communities that represent the variation of ecosystems present. Holland and Coen's (1982, 1983) ecological (biophysical) land classification of the two mountain parks provides a valuable reference in making such determinations.

2) The plot configuration of a 100 × 100 m = 1 ha reference stand divided into 400 5 × 5 m contiguous quadrats is recommended in mountain forest systems in that it allows both stand and local dynamics to be monitored.

3) Ideally monitoring of the structure and composition of the reference stands should be carried out annually as this would provide valuable information on annual dynamics. The workload could be reduced by collecting important data from a small sample of randomly selected quadrats each year and conducting full reference stand inventories only every five or ten years.

4) It would be desirable to permit the reference stands to be truly "permanent" so that re-establishment of the 400 quadrats would not be required each time the site is monitored or inventoried. The permanent tagging of each tree is also recommended in that it would permit the temporal dynamics of individual trees and populations to be monitored. The preferred location of these stands would be well away from tourist areas in order to minimize human impact so the visual appearance of such permanent reference stands should not be a concern.

5 a) Tree diameter should be measured to the nearest mm instead of to a size class to allow more accurate estimations of basal area and other use of tree diameter data.

b) Care should be taken to ensure the accuracy and precision of ocular estimates of understorey species cover to allow comparison of data sets from different researchers in different years. Less observer-biased estimation methods such as the point-cover method could be employed on a subset of quadrats for comparison purposes.

6) The importance of edaphic factors in the spatial distribution of trees and understorey species requires that a thorough survey of soil type, drainage class, texture, and nutrient availability be conducted during the initial establishment of the plots. Soil

nutrients should be re-measured from a more limited sampling regime every five or ten years afterward to detect changes in nutrient availability over time.

7) Inventories of tree health should be included in the stand inventories. The impacts of tree diseases and insect pests were not included in this study, but these factors have proven to be significant in the forest dynamics of other forest systems (Schowalter *et al.* 1986).

It is my hope that a greater understanding of the structure and dynamics of our forests gained from such long-term studies will lead to an enhanced appreciation of their intrinsic value and to practices that will maintain their future integrity.

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APPENDIX A

Table A-1. Density of overstorey species by DBH class at Athabasca in 1967. PC=*Pinus contorta*, PG=*Picea glauca/engelmannii*, PM=*Picea mariana*, AL=*Abies lasiocarpa*, PT=*Populus tremuloides*, SEED=seedlings, TRANS=transgressives (see Chapter 2). DBH class units are in inches.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PC SEED	0	2	2	0	0	0	1	0	1	0	2	0	0	2	1	1	0	0	0	0	4	0	0	0	0	0	0	2	2	0
PG SEED	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	1	0	0	0	1	4	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	7	18	12	11	19	16	12	12	11	15	3	3	12	8	22	6	8	16	14	11	11	10	11	12	3	5	6	1	5	2
PC 3-6	5	0	2	1	2	2	2	3	2	2	1	2	3	2	2	5	3	3	0	0	0	0	2	4	0	6	0	1	0	1
PC 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DEAD	8	9	8	9	8	4	10	13	11	17	1	1	9	16	13	3	9	12	9	9	8	4	5	9	3	8	5	0	2	4

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
PC SEED	10	0	3	0	0	2	1	0	3	0	5	0	0	0	0	0	5	0	0	0	0	2	3	7	0	1	0	0	3	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1	5	5
PG TRANS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	22	14	19	14	14	15	16	16	2	8	3	5	10	5	16	7	4	16	15	20	17	4	1	14	13	6	5	0	0	0
PC 3-6	2	4	2	3	2	3	4	3	0	2	1	1	2	3	2	4	3	2	4	1	3	3	0	2	4	6	0	0	0	0
PC 6-9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PC 12-15	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
DEAD	13	8	4	9	19	30	14	9	3	9	0	3	4	7	14	9	4	6	9	18	11	0	0	2	6	9	9	0	0	0

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
PC SEED	4	5	3	0	0	12	0	0	0	1	0	0	2	3	1	2	0	1	2	11	1	0	4	3	0	1	2	1	1	1
PG SEED	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	2	0	3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	3	0	2	8	7	17	12	8	7	9	6	3	0	2	1	8	4	5	3	7	3	1	0	0	3	8	3	3	8
PC 3-6	1	1	0	0	1	0	1	4	3	2	6	4	4	7	6	5	0	3	6	0	0	2	1	0	0	2	6	3	2	4
PC 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PC 12-15	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	3	0	0	1	9	4	13	5	9	10	9	12	6	3	8	1	1	1	3	0	0	1	0	0	0	3	7	4	1	6

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC SEED	0	1	1	1	0	0	2	0	1	1	0	0	2	0	0	0	0	0	0	1	1	0	3	2	2	4	0	6	0	1
PG SEED	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	2	0	0	0	4	0	2	4	8	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	5	12	5	8	5	6	1	1	2	0	3	0	0	1	2	3	11	11	4	11	6	2	0	0	0	1	0	2	0	0
PC 3-6	6	5	3	1	3	0	0	0	1	0	0	0	0	0	1	4	2	5	3	0	5	3	3	4	0	2	0	0	0	0
PC 6-9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0
PC 9-12	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
PC 12-15	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
DEAD	8	8	5	6	4	2	0	0	0	0	0	0	0	0	0	2	15	10	14	5	4	6	1	0	0	0	0	0	0	0

	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
PC SEED	1	11	4	0	1	1	0	1	0	2	1	0	0	0	0	0	0	0	0	1	1	0	2	0	0	2	2	0	2	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	2	3	1	0	0	0	1	0	0	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	4	0	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	2	5	9	1	2	1	0	4	6	5	8	14	13	19	4	0	0	0	0	0	2	0	1	0	0	11	19	12	9	12
PC 3-6	1	3	0	1	4	3	1	3	4	5	3	7	2	0	0	0	0	0	0	0	1	0	0	0	0	2	3	3	4	5
PC 6-9	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	1	0	0	0	0	1	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	2	0	2	0	0	4	7	14	10	9	10	15	3	0	0	0	0	0	0	0	0	0	0	3	7	12	7	4

	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
PC SEED	1	0	1	2	0	2	2	3	0	2	0	0	3	0	0	0	0	0	2	0	0	0	1	0	0	0	2	3	0	5
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0
AL SEED	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	2	0	1	1	0	2	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 1-3	12	2	0	0	0	6	10	3	1	2	1	0	5	15	6	3	4	0	0	11	4	16	6	8	19	18	3	11	3	1
PC 3-6	5	4	0	1	1	4	2	0	1	1	2	0	2	1	5	2	3	2	2	3	2	1	0	0	2	0	0	3	4	1
PC 6-9	0	0	0	1	0	0	0	0	1	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	10	4	0	0	0	6	7	0	0	0	0	1	2	7	4	7	2	0	0	5	16	8	0	0	16	7	0	2	0	0

Table A-1. Continued (Athabasca overstorey 1967).

	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
PC SEED	4	0	0	0	1	1	1	0	2	0	8	2	4	2	0	1	0	1	0	1	0	0	4	0	1	0	1	0	0	0
PG SEED	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	1	0	1	0	4	0	0	2	2	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	0	4	5	16	14	3	7	12	7	1	0	1	0	5	3	11	8	0	0	1	1	5	6	7	4	2	6	7	4
PC 3-6	3	1	3	1	3	5	4	4	4	4	2	1	0	1	2	4	5	1	0	1	2	0	3	2	1	0	2	2	4	2
PC 6-9	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	1	0	1	0	0	0	0	1
PC 9-12	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	3	3	7	11	9	3	6	11	11	0	2	3	1	0	4	5	0	1	0	0	1	5	8	2	1	2	0	0

	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
PC SEED	0	4	0	3	0	0	0	2	0	7	0	0	0	0	0	0	2	1	1	1	0	0	1	0	0	0	0	1	1	2
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	1	0	0	0	0	0	0	3	1	0	0	0	1	0	1	0	0	0	0	3	1	1	2	4	1	1
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	3	4	8	12	14	9	16	15	2	1	0	4	16	12	7	2	5	4	6	2	0	2	4	2	0	1	1	2	1	0
PC 3-6	2	4	3	4	1	2	2	3	0	1	0	1	0	4	3	1	2	2	7	2	2	4	0	0	0	0	1	0	0	1
PC 6-9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
DEAD	0	3	4	9	9	12	4	3	0	0	0	0	7	10	2	1	1	2	0	0	1	0	2	0	0	0	0	0	0	0

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
PC SEED	0	1	0	0	0	0	0	0	1	0	2	4	4	3	2	2	1	1	4	1	1	1	1	0	0	2	2	1	2	0
PG SEED	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	8	3	1	1	0	2	0	1	0	0	0	1	0	2	0	2	0	3	0	0	0	3	4
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	1	0	0	0	2	0	2	3	4	0	0	1	0	0	7	1	8	4	0	4	4	5	9	10	0	0	0	0	2
PC 3-6	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	5	4	2	0	3	2	3	4	0	2	1	0	0	1	1
PC 6-9	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	3	2	1	2	2
PC 9-12	0	0	0	0	1	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PC 12-15	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	15	10	2	0	4	1	4	2	3	3	0	0	0	0

	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
PC SEED	0	0	0	2	2	2	2	2	1	1	0	0	0	0	0	0	1	0	0	0	1	2	0	0	4	1	1	0	0	0
PG SEED	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	4	0	0	0	0	0	5	4	0	0	2	0	2	1	0	8	2	0	1	3	2	1	0	2	1	1	0	0	0	2
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	3	0	0	0	1	3	8	2	1	1	8	4	8	3	8	0	0	0	0	0	1	0	0	2	0	8	8	8	5	7
PC 3-6	0	0	0	2	2	2	0	1	2	0	2	3	3	5	2	0	0	0	2	1	0	0	1	1	4	5	3	3	4	2
PC 6-9	1	2	0	0	0	0	0	2	1	0	0	0	0	0	0	1	1	1	0	0	0	1	2	0	0	0	0	0	0	0
PC 9-12	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
DEAD	1	0	0	0	0	0	6	4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	4	3

	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
PC SEED	0	0	0	3	3	0	1	0	1	1	3	3	0	1	0	0	0	1	0	1	1	2	1	0	0	0	0	0	7	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	2	0	2	2	1	0	3	0	1	1	6	4	2	0	7	1	1	0	1	1	4	2	0	0	1	1	0	2	4
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
PC 1-3	6	1	5	2	6	3	1	5	3	0	0	6	4	3	3	3	0	1	2	6	0	0	1	0	0	5	3	2	7	2
PC 3-6	1	0	2	0	1	4	2	2	1	0	1	1	0	0	2	1	0	1	0	2	0	1	1	0	5	1	0	1	0	0
PC 6-9	0	1	0	1	0	2	2	0	1	1	2	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	2	6	1	1	0	0	2	0	0	0	1	0	2	0	0	0	0	2	0	0	0	0	3	6	2	1	0	0

	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
PC SEED	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	1	2	1
PG SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	1	2	3	6	2	2	2	1	5	0	0	2	2	3	3	2	10	4	6	0	0	0	0	0	0	0	6	2	5
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	9	7	12	1	3	2	6	7	6	3	0	5	4	2	0	0	0	2	9	3	2	1	1	1	5	3	1	0	1	4
PC 3-6	1	0	4	2	1	0	0	3	2	1	0	1	1	0	0	0	0	2	0	0	1	1	2	0	0	0	2	1	0	4
PC 6-9	0	0	0	0	0	0	3	0	0	1	3	0	0	1	0	0	2	1	1	0	1	0	0	1	0	0	0	0	0	0
PC 9-12	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DEAD	1	2	3	0	0	0	0	0	0	0	0	3	2	2	0	1	0	2	0	0	0	0	0	1	0	0	1	0	0	2

Table A-1. Continued (Athabasca overstorey 1967).

	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	1	0	0	0	0	2	0	7	3	2	2	1	2	4	1	4	4	2	5	2	1	5	3	2	4	2	2	2	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	8	3	0	0	6	8	9	5	6	4	0	0	0	1	0	0	0	3	4	1	0	13	3	0	2	7	3	3	2	3
PC 3-6	1	3	0	3	6	5	3	2	4	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	3	0	1	2	0	3
PC 6-9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	3	1	1	0	2	0	1	0	1	1	0	0	0	0
PC 9-12	0	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	3	0	0	0	1	0	0	11	3	0	0	0	0	0	0	0	0	0	1	0	0	3	2	0	0	0	1	0	0	0

	391	392	393	394	395	396	397	398	399	400
PC SEED	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	0	1	1	0	0	1	2	0	0
PG TRANS	0	0	0	0	0	0	0	0	9	0
PC 1-3	1	6	8	1	10	3	0	1	5	3
PC 3-6	2	3	1	0	2	1	2	1	0	2
PC 6-9	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	1	0	1	0	1	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	1	1	3	1	1	2	0	3

Table A-2. Density of overstorey species by DBH class at Athabasca in 1967.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PC SEED	0	3	3	4	1	0	1	0	1	6	0	0	1	2	1	1	1	1	1	1	5	5	2	1	0	1	7	2	2	1
PG SEED	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	1	1	1	0
PG TRANS	0	0	1	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
AL TRANS	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	0	3	4	6	9	3	7	11	3	1	1	4	0	7	0	7	5	3	4	5	3	2	2	0	1	2	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	5	7	4	3	7	7	4	4	5	10	2	3	5	8	2	3	1	3	3	2	2	1	4	6	2	4	0	1	3	1
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	1	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	6	5	6	2	2	2	7	1	5	6	0	0	3	6	4	3	5	5	2	4	4	1	2	3	1	0	1	0	2	1

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
PC SEED	0	8	1	3	1	0	4	1	5	0	0	1	0	0	0	1	4	0	1	0	0	3	11	9	1	0	1	0	2	0
PG SEED	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2	1	1	0	0	0	0	0
AL SEED	1	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	0	0	0	0	1	0	0	2	0	1	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	4	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	2	1	2	0	0	1	3	4	3
PG TRANS	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	5	4	3	3	7	5	5	0	1	2	0	2	4	2	2	2	1	4	4	6	1	0	0	0	3	2	2	0	1	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	5	5	7	3	5	6	6	0	2	3	2	3	3	5	6	3	5	6	2	3	3	0	4	6	5	2	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	5	3	3	4	3	3	4	5	2	7	1	2	11	5	5	0	2	2	0	4	2	1	1	6	1	3	2	0	0	0

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
PC SEED	0	8	0	0	5	0	0	2	5	1	0	0	1	4	1	0	1	4	1	5	2	1	0	1	2	1	2	1	2	0
PG SEED	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	3	7	5	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	4	6	0	0	3	2	0	0	0	2	0	0
PG TRANS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	1	2	0	7	2	2	2	4	2	0	1	1	0	1	1	3	2	2	0	3	2	0	0	0	1	2	0	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	1	0	1	0	0	4	5	4	2	4	6	3	3	3	2	0	5	6	1	0	1	1	0	0	3	4	3	3	6
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	0	0	0	0	0	0	0	1	1	1	2	1	1	1	0	1	0	0	0	0	0	0	0	1	2	1	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	0	1	1	1	10	6	5	8	6	6	2	1	3	2	3	2	3	0	2	2	1	1	0	4	4	3	0	4

Table A-2. Continued (Athabasca overstorey 1989).

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC SEED	0	2	1	1	1	0	2	0	0	4	0	0	5	2	7	1	0	0	0	0	1	0	2	4	1	4	1	7	0	0
PG SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0
AL SEED	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	2	1	0	3	2	2	1	2	7	0	0	0	0	0	0	0	0	0	2	0	0	1	0	1	0	2
PG TRANS	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0
PC 1-3	1	3	1	3	1	3	0	0	0	0	3	0	0	0	1	0	6	2	2	0	0	0	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	8	6	3	5	2	1	0	1	1	0	0	0	0	0	0	4	6	6	3	1	3	2	2	2	0	1	0	2	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	1	1	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
PC 12-15	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
DEAD	1	4	2	3	6	3	0	1	0	0	0	0	1	0	1	2	5	5	5	2	2	2	3	0	0	0	0	0	1	0

	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
PC SEED	0	1	1	2	1	1	1	0	1	2	2	0	3	1	1	0	0	0	0	1	1	1	5	2	0	2	0	0	0	2
PG SEED	0	1	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	2
AL SEED	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	1	0	0	5	0	0	1	0	0	0	0
PG TRANS	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	3	3	0	0	0	0	1	1	0	0	0	7	7	2	0	0	0	0	0	1	0	0	0	0	2	7	2	3	6
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	4	1	1	1	3	1	4	4	3	4	5	4	1	0	0	0	0	0	0	2	0	0	0	0	5	4	4	4	5
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	1	1	2	2	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DEAD	1	1	5	0	2	0	0	1	5	3	6	7	2	4	0	2	0	1	0	0	0	0	0	0	0	2	7	3	3	4

	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
PC SEED	4	2	3	1	3	1	1	3	0	2	1	1	3	2	0	1	0	5	6	1	1	0	0	0	0	1	3	3	3	1
PG SEED	0	0	1	0	0	0	1	1	0	0	0	0	3	5	1	1	0	0	0	0	0	0	0	1	0	3	0	0	1	0
AL SEED	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	1	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	1	1	0	0	0	2	2	1	0	1	0	0	0	0	0	1	2	0	0	0	0	0	0	1	2	3	1	2
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	0	0	0	0	0
AL TRANS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	4	1	0	0	0	1	4	1	0	1	0	0	2	3	0	1	1	0	0	2	2	4	1	2	7	4	0	3	1	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	3	4	0	1	1	4	3	1	3	1	0	0	4	3	3	4	3	0	3	4	1	3	1	3	2	2	0	4	3	1
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 6-9	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0	0	1	1	1	0	0	0	0	0	0	1	0	1	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	3	4	0	0	1	4	3	2	0	0	1	0	0	7	3	1	4	0	0	4	1	2	0	1	0	2	0	1	2	0

	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
PC SEED	1	1	1	0	3	3	0	0	3	1	10	3	6	1	0	1	1	1	2	1	1	0	4	3	1	0	0	1	5	1
PG SEED	0	0	0	0	1	0	0	1	1	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	1	0	0	1	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	0	1	0	0	0	1	1	0	0	4	2	1	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	2
PG TRANS	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
AL TRANS	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	2	3	3	2	4	3	2	3	0	0	0	0	2	0	2	4	0	0	1	1	0	3	3	0	0	1	1	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	2	0	3	1	5	4	5	3	3	2	3	0	1	1	1	2	9	4	0	1	3	0	4	2	1	1	1	4	3	3
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	2	0	0	1	0	0	0	0	0	2	3	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	2	1	1	0	2	1	1	2	2	1	0	0	1	0	2	1	3	4	0	0	0	0	2	2	3	1	1	3	1	1

Table A-2. Continued (Athabasca overstorey 1989).

	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
PC SEED	2	1	2	4	0	0	0	1	1	10	4	2	0	0	1	3	3	6	1	4	1	0	1	0	0	0	1	2	1	1
PG SEED	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	2	1	3	0	2	0	0	0	0	3	2	0	1	0	0	1	0	0	0	0	1	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
AL TRANS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	1	2	1	2	4	2	0	0	0	0	5	3	2	2	4	0	0	0	0	0	1	1	0	0	2	1	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	3	4	5	2	4	2	3	0	3	1	1	1	2	6	1	2	1	4	1	0	3	1	0	0	0	0	0	0	1
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	0	1	0	0	1	1	0	0	1	1	0	1	0	0	0	0	2	1	0	1	0	0	1	1	0	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	2	6	4	6	5	7	2	0	1	0	1	2	4	3	0	1	2	2	2	1	2	2	1	0	0	2	0	1	0

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
PC SEED	2	0	2	1	3	0	0	0	1	1	6	1	4	2	3	2	4	5	5	5	3	0	1	1	3	0	0	1	1	0
PG SEED	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	0	3	0	0	0	0	4	1	0	0	0	2	4	1	0	0	1	4	1	0	1	0	0	0	2	2	1	0	0
PG TRANS	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	2	1	2	0	1	0	0	2	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	0	0	0	0	0	0	1	2	2	0	0	0	1	0	7	4	5	1	0	4	4	4	5	4	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	2	0	0	1	1	0	2	2	0	1	2
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	0	1	1	0	2	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	2	2	0	1	2
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DEAD	0	0	0	2	0	1	0	0	0	3	0	0	0	0	0	2	5	5	0	1	2	3	1	1	2	2	0	1	0	0

	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
PC SEED	0	2	0	0	2	3	1	3	1	2	2	0	0	0	0	3	2	0	1	0	1	0	1	3	2	0	0	1	0	0
PG SEED	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
AL SEED	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	1	0	2	1	2	3	1	1	0	0	0	1	0	2	2	2	0	2	4	2	3	0	4	0	0	0	0	0	1
PG TRANS	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	2	0	0	0	1	1	3	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	3
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	0	0	0	0	2	2	3	0	1	3	5	4	4	4	0	0	0	0	0	0	0	0	0	4	3	3	4	7	3
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	2	2	0	0	0	0	0	2	1	0	0	0	0	0	1	1	0	2	0	0	0	2	0	0	1	0	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	2	2	0	0	0	0	0	2	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	2	0	0	0	1	1	4	4	0	4	3	5	4	1	0	0	1	0	0	0	1	1	1	0	3	3	2	3	2

	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
PC SEED	4	1	3	3	2	1	0	1	6	3	2	2	1	2	0	0	2	3	0	1	0	1	0	0	1	1	0	0	0	1
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
AL SEED	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	5	2	0	1	0	0	1	1	2	2	1	0	1	4	0	1	1	1	0	0	0	2	1	0	0	2	1	3	2	3
PG TRANS	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	2	0	0	0	2	0	0	0	2	0	1	3	0	0	2	1	0	0	0	0	0	0	1	0	0	2	0	0	2	2
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
PC 3-6	1	2	2	1	4	1	2	0	3	0	0	1	0	2	0	3	1	0	0	3	0	1	0	0	2	3	0	3	3	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	1	0	0	1	0	0	0	0	1	0	0	0	2	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DEAD	3	1	1	2	2	2	0	0	1	0	0	1	0	2	0	1	0	1	0	2	0	0	1	0	2	2	0	1	0	1

Table A-2. Continued (Athabasca overstorey 1989).

	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
PC SEED	1	1	0	3	4	1	0	0	2	2	0	1	3	1	0	0	0	0	2	4	0	0	3	2	0	3	2	1	1	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	4	0	0	4	2	4	0	0	2	7	2	1	3	4	2	2	1	1	0	4	0	1	0	0	0	0	0	1	3	0
PG TRANS	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
AL TRANS	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	2	1	2	0	5	0	0	0	0	1	0	1	1	0	1	0	0	2	4	2	0	0	0	0	1	0	1	1	1	5
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	7	4	0	0	0	2	1	2	1	0	2	1	0	0	0	0	0	2	1	0	0	1	1	0	0	2	0	1	3
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	1	0	0	3	1	0	0	2	0	1	1	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	1	1	1	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DEAD	1	0	4	1	1	1	1	6	2	2	1	1	1	0	0	0	0	0	0	2	1	0	1	2	3	3	0	0	0	1

	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
PC SEED	0	0	0	3	2	1	3	0	1	0	1	0	0	6	3	1	1	3	4	0	0	1	4	6	0	0	3	0	1	0
PG SEED	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	1	2	2	0	0	0	0	0	1	1	1	0	2	2	1	1	2	4	3	3	1	1	3	0	1	1	1	3	0
PG TRANS	15	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PT TRANS	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
PC 1-3	2	0	0	0	1	1	3	3	2	4	0	0	0	0	0	0	0	2	3	0	0	3	1	0	1	3	1	2	0	0
PG 1-3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	3	0	1	5	2	3	4	4	1	0	0	0	0	0	0	0	0	1	0	0	2	2	0	2	1	2	3	0	4
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	0	0	0	0	0	0	0	1	1	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	5	0	0	1	5	6	4	7	5	0	0	0	0	0	0	1	1	1	0	1	0	1	1	0	1	0	1	0	0	1

	391	392	393	394	395	396	397	398	399	400
PC SEED	0	0	3	2	0	0	1	1	0	1
PG SEED	0	0	1	0	0	0	0	2	2	0
AL SEED	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	1	0	1	0
PC TRANS	1	0	0	0	0	0	0	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	8	3
AL TRANS	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	1	2	1	0
PC 1-3	0	1	1	0	0	1	0	1	0	0
PG 1-3	0	0	0	0	0	0	0	0	2	0
PC 3-6	2	0	2	2	2	1	2	0	2	3
PG 3-6	0	0	0	0	0	0	0	0	1	2
PC 6-9	0	3	0	0	1	0	0	1	0	0
PM 6-9	0	0	0	0	0	0	0	1	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	1	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	1	0	0
DEAD	1	1	1	2	5	2	1	0	0	3

Table A-3. Density of overstorey species by DBH class at Sunwapta in 1967.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PC SEED	6	3	5	4	0	0	3	4	0	2	3	4	5	1	2	5	30	52	34	17	9	12	3	0	11	10	9	6	8	6
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
PC TRANS	3	9	2	0	0	0	0	0	0	0	5	7	1	1	0	4	23	55	32	19	0	5	8	1	4	6	0	0	7	8
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	0	2	1	1	0	3	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	0	0	1	0	2	1	1	2	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	1	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
PC SEED	6	4	7	4	8	4	5	7	7	10	0	5	8	9	6	8	13	18	12	6	2	2	10	13	20	8	8	5	2	3
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PC TRANS	5	3	5	0	0	3	2	6	4	6	8	8	11	11	6	0	3	3	7	4	4	0	0	8	4	2	0	0	0	6
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	1	1	0	2
PC 9-12	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	2	1	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
PC SEED	4	9	6	11	17	14	10	6	1	8	7	2	6	8	5	3	7	3	10	21	9	11	10	4	5	3	1	3	5	6
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	1	4	0	8	10	2	4	2	7	9	6	7	3	3	7	5	4	7	8	1	3	4	0	1	2	1	0	7	2
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	1	0	0	0	0	0	0	6	6	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	1
PC 3-6	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
PC 6-9	0	1	2	2	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0
PC 12-15	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	3

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC SEED	3	7	8	8	8	5	3	0	8	3	5	3	3	15	14	32	17	11	8	0	7	3	5	14	12	16	5	7	3	3
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	2	7	11	8	6	0	0	0	3	0	0	0	0	3	11	17	20	12	9	9	8	8	12	0	3	2	4	4	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	6	8	5	5	0	0	0	0	0	0	0	0
PC 3-6	4	0	0	0	0	0	1	1	1	0	0	2	2	0	0	0	0	0	1	1	2	3	0	0	0	1	0	0	0	1
PC 6-9	1	0	0	0	0	0	0	2	1	1	1	1	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	1
PC 9-12	0	0	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
PC 12-15	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
PC SEED	2	4	7	8	9	5	6	4	11	15	22	10	8	16	21	39	19	27	12	5	8	3	5	14	30	10	9	6	10	8
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	5	2	2	0	0	4	10	11	14	15	1	3	10	10	14	6	2	4	3	0	4	7	9	2	0	9	6	21
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	0	0	0	0	0	0	0	2	8	9	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PC 3-6	2	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0
PC 6-9	2	1	1	1	0	2	0	0	0	1	0	0	0	0	1	0	1	0	0	0	2	1	1	0	0	1	0	0	0	0
PC 9-12	0	1	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	2	1	0	1	0	1	0	1
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-3. Continued (Sunwapta overstorey 1967).

	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
PC SEED	12	13	8	4	4	4	2	3	8	5	12	9	2	2	12	5	6	3	14	5	6	7	10	8	18	4	8	4	3	4
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	12	12	3	1	0	0	0	7	3	0	11	9	3	0	0	1	1	10	10	21	8	9	7	6	5	2	3	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	5	3	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1
PC 6-9	0	0	0	0	1	2	0	1	0	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	2	1	2	1	0
PC 9-12	0	0	0	0	1	2	1	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
PC SEED	3	4	0	0	2	1	12	45	27	17	21	11	24	3	3	3	15	21	21	27	19	9	2	3	8	6	3	7	26	12
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	1	0	2	1	0	11	9	8	7	9	14	3	14	7	3	7	12	12	12	10	4	6	8	9	12	0	0	26	19
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0	0	3	0	0	0	0	1	0	0	1
PC 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0
PC 6-9	0	0	3	1	0	2	0	0	0	0	0	0	0	0	1	2	0	0	0	0	2	1	1	0	0	0	0	0	0	0
PC 9-12	2	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2	1	0	0	1	0	0	0
PC 12-15	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
PC SEED	9	23	9	10	5	8	3	0	8	2	12	12	9	4	8	11	5	8	7	6	8	21	23	27	7	6	10	6	7	5
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	4	5	14	4	3	3	3	1	5	1	16	15	9	15	10	3	6	9	15	9	12	21	6	3	3	3	14	7	2	11
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	1	0
PC 3-6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	0
PC 6-9	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	2	0
PC 9-12	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 12-15	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
PC SEED	3	9	10	8	3	7	35	25	8	11	13	11	17	6	16	13	4	4	4	6	10	5	11	42	51	17	16	8	19	26
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PC TRANS	8	6	10	12	2	2	4	7	5	5	11	14	22	17	16	14	7	5	7	14	13	3	10	13	28	31	3	9	17	7
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 1-3	1	5	3	1	0	0	0	0	0	0	0	0	0	2	3	1	1	0	0	0	0	0	0	1	1	3	2	0	0	0
PC 3-6	0	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
PC 6-9	0	1	0	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2
PC 9-12	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	1	0	0
PC 12-15	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
PC SEED	11	18	6	2	6	6	19	6	5	6	9	7	7	9	6	6	10	10	4	13	12	14	17	16	12	23	8	11	6	9
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PC TRANS	6	5	0	0	3	15	9	3	10	20	19	7	12	9	9	9	4	3	0	3	3	4	7	12	10	23	21	27	7	15
PG TRANS	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	3	2	2	2	0	0	2	0	2	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0
PC 3-6	0	0	0	0	0	0	1	2	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	3	3	0	0	1	2	1	0	1	2	0	1	0	0	0	1	2	0	1	0	0	1	0	0	0	0	0	1
PC 9-12	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	0	1	1
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Table A-3. Continued (Sunwapta overstorey 1967).

	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
PC SEED	9	9	16	18	34	19	11	1	8	4	4	5	3	3	1	3	2	4	3	1	5	5	3	0	2	0	0	1	0	2
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	13	6	19	13	28	14	5	0	4	4	3	0	1	3	5	10	6	3	15	4	11	6	8	12	11	5	4	3	3	1
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	3	0	3	5	3	0	0	0	0	0	0	0	0	1	1	0	1	1	1	3	1	3	1	0	0	0	0	0	1	0
PC 3-6	0	0	0	1	0	0	0	2	0	1	0	1	0	0	0	0	1	0	1	0	0	2	1	0	2	0	0	0	0	1
PC 6-9	1	2	0	0	0	0	1	2	0	1	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	1	1
PC 9-12	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
PC SEED	0	1	0	5	8	16	11	16	8	7	7	1	8	4	2	2	5	7	0	4	7	10	8	4	2	7	10	4	6	6
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	1	1	3	10	27	15	18	2	1	2	0	6	14	9	3	19	7	0	5	6	12	10	10	14	21	18	7	9	15
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	1	6	5	0	0	0	1	0	0	0	0	0	3	0	2	1	1	0	1	0	1	2	4	1	4	5
PC 3-6	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	2	1	2	0	1
PC 6-9	3	3	1	1	1	0	0	0	1	1	1	2	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	1	0
PC 9-12	0	0	0	0	0	0	1	0	0	0	1	1	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
PC SEED	2	4	2	0	6	2	1	5	3	4	1	6	6	2	5	3	5	3	1	4	0	1	10	7	10	14	5	5	6	6
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	3	0	0	4	0	0	1	0
PC TRANS	2	18	8	12	12	3	2	8	4	10	7	2	7	7	4	9	6	3	4	4	0	4	2	4	1	5	13	18	8	2
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	0	0	0	1	1	1	1	0	2	2	3	7	0	0	0
PC 1-3	2	2	2	2	3	1	0	0	0	3	2	4	0	0	0	3	1	0	0	2	2	0	1	2	1	7	5	2	2	2
PC 3-6	0	1	2	2	0	0	0	0	0	3	0	1	1	1	0	0	0	1	0	0	1	0	0	0	3	0	3	0	1	2
PC 6-9	1	0	0	0	0	0	1	0	0	1	3	0	2	1	0	0	1	1	0	0	1	1	1	0	0	0	0	0	1	0
PC 9-12	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	6	2	2	0	0	0

	391	392	393	394	395	396	397	398	399	400
PC SEED	2	0	0	9	4	2	2	4	7	12
PG SEED	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	5	5	9	12	18	19	25	22	20
PG TRANS	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0
PC 1-3	2	0	0	1	1	4	4	2	0	1
PC 3-6	0	0	0	0	2	0	1	1	1	0
PC 6-9	0	1	1	0	1	0	0	0	0	1
PC 9-12	0	0	0	0	0	0	0	0	0	0
PC 12-15	1	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	1	0	0	0

Table A-4. Density of overstorey species by DBH class at Sunwapta in 1989.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PC SEED	0	0	0	0	0	1	0	3	0	0	0	1	0	2	1	0	2	3	6	3	3	4	3	2	2	2	9	0	6	4
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	8	3	3	5	0	1	2	2	0	1	7	11	3	3	9	9	38	53	35	22	8	12	6	8	21	15	9	6	11	13
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	0	0	1	1	0	2	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	2	0	2	1	2	1	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0
PC 12-15	0	1	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
PC SEED	5	2	6	0	0	1	1	0	1	0	1	3	1	0	1	7	2	12	4	6	3	1	1	0	0	1	0	0	0	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
AL SEED	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	12	11	6	0	2	7	2	7	5	9	7	7	17	12	6	4	6	11	12	4	1	1	1	4	22	27	19	2	0	3
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0
PC 9-12	1	0	0	1	1	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	2	0	1
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	1	1	1
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
PC SEED	0	1	2	4	4	2	1	0	0	1	3	1	5	0	2	0	2	1	3	4	0	1	2	0	6	1	0	1	1	1
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	3	14	6	11	22	18	4	3	2	7	6	2	7	4	1	7	10	4	7	18	5	10	12	1	3	5	2	2	3	6
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	1	0	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
PC 6-9	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
PC 9-12	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
PC 12-15	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	1	0	1	1	0	0	0	0	0	1	1	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DEAD	0	0	1	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC SEED	2	2	0	1	0	1	2	0	0	2	1	0	0	4	6	3	0	1	0	5	2	2	5	1	10	9	8	13	6	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	10	16	11	9	6	1	0	6	5	4	1	2	11	28	33	37	15	12	4	4	2	13	7	11	12	4	23	2	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	1
PC 6-9	4	0	0	0	0	0	0	2	1	0	1	3	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	1
PC 9-12	1	0	0	0	0	0	0	1	1	1	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1
PC 12-15	0	0	0	0	1	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0

Table A-4. Continued (Sunwapta overstorey 1989).

	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
PC SEED	0	1	6	2	4	2	2	3	2	3	4	0	0	0	2	3	3	2	2	2	0	0	3	2	1	0	1	0	2	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	0	2	9	9	7	3	7	3	16	12	15	3	15	20	36	34	24	12	5	11	4	6	18	19	4	6	3	8	13
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	1	1	2	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 6-9	2	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0
PC 9-12	2	2	0	1	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	2	1	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1
PC 15-18	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0

	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
PC SEED	4	5	4	6	0	0	2	2		3	6	4	3	1	3	2	1	0	3	2	4	3	5	2	5	3	3	0	0	0
PM SEED	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	15	8	10	3	1	0	0	7	8	10	25	22	8	2	1	1	6	8	24	7	15	9	13	11	21	6	18	2	1	1
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	2	0	0
PC 9-12	0	0	0	0	0	1	1	1	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	2	0	1	1	0
PC 12-15	0	0	0	0	2	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0

	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
PC SEED	1	0	0	0	3	0	7	10	11	7	6	8	5	2	1	2	2	7	5	3	1	4	2	1	1	5	0	5	6	9
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	2	4	0	4	1	3	14	31	27	11	9	18	10	12	5	7	7	18	25	16	14	4	8	6	13	11	3	2	21	19
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	2	1	0	0	1	1	0	2	2	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0
PC 6-9	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
PC 9-12	2	1	1	1	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	1	2	1	2	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0

	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
PC SEED	9	4	6	3	1	5	5	0	1	0	1	1	0	2	5	4	1	2	5	0	6	5	13	10	6	2	7	10	3	3
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
PT SEED	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	11	17	11	18	2	14	10	4	13	9	23	28	17	19	13	3	2	8	15	6	12	13	20	13	4	4	13	10	4	6
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	1	0	1	0	3	0	0	1	0	0	0	0	0	0	1	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	1	0
PC 9-12	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0
PC 12-15	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
PC SEED	2	3	10	3	5	6	9	8	2	3	4	6	18	3	4	11	2	1	2	2	1	0	6	7	10	8	9	7	5	14
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	10	11	8	7	0	6	22	17	12	12	11	13	18	7	12	17	13	1	10	15	14	3	10	39	52	37	17	12	41	18
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	1	0	1	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	2	2	0	0	0	0	0	1	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
PC 6-9	0	1	1	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PC 9-12	0	0	0	0	2	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	1	2
PC 12-15	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	2	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	2	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

Table A-4. Continued (Sunwapta overstorey 1989).

	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
PC SEED	9	3	2	0	6	2	6	2	4	1	1	3	1	7	7	0	1	5	1	0	5	4	3	3	4	4	6	0	7	1
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	15	21	3	0	9	11	12	4	8	9	11	18	8	4	17	10	2	5	4	0	6	14	23	10	23	14	25	17	22	12
PG TRANS	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	1	0	1	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	3	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	1	2	1	0	0	0	1	0	1	0	1	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	1	0	0	1	2	1	0	1	1	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	1
PC 12-15	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
DEAD	0	0	0	1	0	0	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0

	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
PC SEED	2	1	5	6	4	4	2	0	3	4	3	1	2	1	1	0	1	2	2	1	1	2	0	1	0	0	2	1	1	1
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	15	4	16	18	19	16	12	2	14	5	5	1	1	3	6	8	6	5	8	8	10	13	15	10	8	6	2	6	2	1
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	0	2	1	2	1	0	0	0	0	0	0	0	1	1	0	1	2	0	2	3	3	0	1	0	0	1	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PC 6-9	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	0	1	1	0	2	0	0	0	1	1
PC 9-12	1	1	0	0	0	0	1	3	1	1	0	1	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	1	0	0	0	0	0	1	[illegible]	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
DEAD	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
PC SEED	0	0	2	1	3	5	1	4	1	2	1	0	3	4	1	0	2	1	2	2	2	2	1	3	2	3	3	3	3	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	1	2	8	16	24	14	17	4	7	4	3	10	15	9	7	9	17	3	4	7	14	18	9	10	10	22	19	10	13
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	3	1	1	1	0	0	1	0	1	2	1	0	2	4
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	[illegible]	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	1	0	1	1
PC 6-9	2	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 9-12	3	1	1	0	0	0	0	0	0	1	1	2	0	0	2	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0
PC 12-15	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	1

	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
PC SEED	1	2	2	0	1	1	0	3	1	1	2	4	0	3	5	2	4	1	1	5	3	3	8	14	7	11	7	3	4	1
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
PC TRANS	7	11	7	6	14	7	4	3	5	4	3	8	7	15	4	7	4	4	1	13	20	6	12	16	31	23	11	11	7	3
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0
PC 1-3	0	2	1	1	0	0	0	0	0	2	0	2	2	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	3	0	1	0	0	0	0	3	0	1	1	0	0	0	0	1	0	0	1	0	1	1	0	1	2	0	1	1
PC 6-9	0	1	0	0	1	0	0	0	0	2	2	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2	0
PC 12-15	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0

	391	392	393	394	395	396	397	398	399	400
PC SEED	0	0	0	0	1	2	0	3	3	5
PM SEED	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	1	0	0	0	0	0	0	1
PT SEED	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	4	4	15	13	18	29	21	35	33
PG TRANS	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0
PC 1-3	1	0	0	1	2	2	1	4	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	2	1	1	2	1	1
PC 6-9	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	1	1	0	0	0	0	0	1
PC 12-15	1	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	2	0	0	0	0	1

Table A-5. Density of overstorey species by DBH class at Whirlpool in 1967.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PC SEED	0	0	0	0	0	2	1	0	0	2	1	1	1	0	1	0	0	0	0	0	1	0	2	6	2	2	6	0	3	2
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0
AL SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	2	0	0	0	2	0	2	0
PM TRANS	0	12	17	15	27	16	18	4	25	19	15	0	0	0	0	0	7	17	0	17	6	2	15	5	0	0	0	18	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	2	2	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	2	3	3	0	2	0	2	0	3	0	1	0	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0	1	0
PM 3-6	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	4	4	2	3	3	2	1	3	1	3	1	0	2	1	2	2	3	0	5	4	3	0	3	1	2	2	0	0	2	3
PM 6-9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	0	0	0	1	0	0	0	0	0	1	0	1	1	2	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
DEAD	4	0	4	2	2	3	3	2	1	1	0	1	0	1	1	0	0	1	1	1	2	1	2	1	1	3	0	0	2	2

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
PC SEED	0	0	0	3	0	4	0	0	0	0	0	0	2	2	1	1	2	1	3	1	7	7	3	0	4	0	2	2	1	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	2	0	0	0
PM TRANS	38	0	10	0	18	0	0	15	17	7	0	0	0	2	0	0	3	2	7	0	0	0	0	0	0	0	0	6	0	15
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	2	1	1	1	0	2	1	0	3	2	2	2	1	0	1	3	0	0	1	1	0	0	1	0	0	1	0	0	0	1
PM 3-6	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	5	1	1	1	2	2	2	4	2	2	1	2	2	2	2	3	2	2	3	3	1	2	1	2	0	0	2	3	1
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	2	0	1	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	1	0	0	4	1	2	2	5	2	1	3	1	3	2	0	1	1	0	1	0	0	1	1	0	0	1	2	0

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
PC SEED	7	2	3	1	3	1	0	1	0	0	3	1	3	1	0	0	1	2	0	0	0	0	10	0	0	0	1	0	3	0
PM SEED	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	2
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PT SEED	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	0	3	2	0	0	0	0	3	3	3	0	0	0	0	0
PC TRANS	2	3	3	0	0	0	0	0	2	1	0	0	3	0	0	0	1	0	2	0	0	0	10	0	1	1	0	0	4	0
PM TRANS	1	1	4	0	0	0	0	0	0	2	1	1	0	0	0	31	0	0	27	13	25	0	0	0	17	8	9	0	0	34
PG TRANS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	10	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PM 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	0	0	0	1
PG 1-3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	1	0	1	0	0	0	0	0	1	0	0	2	1	3	0	0	0	2	3	2	1	0	1	2	1	1	1	0	1
PM 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	2	0	0	0	0	1
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	1	3	0	3	1	0	2	1	1	3	1	4	2	2	2	0	4	4	2	3	1	2	0	1	2	1	3	1
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	3	0	0	1	1	3	0	0	0	0	0	2	0	0	4	5	0	0	3	3	2	1	1	1	2	5	0	2	0	2

Table A-5. Continued (Whirlpool overstorey 1967).

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC SEED	0	0	0	1	0	0	1	0	4	0	0	1	1	1	2	2	3	0	2	0	0	0	2	0	0	0	4	5	0	0
PM SEED	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	1	0	0	0	2	0	0	1	1	2	2	2	0	0	0	0	0	0	0	0	0	5	13	8	0	0
PM TRANS	13	9	2	7	7	0	0	0	0	0	0	0	0	0	0	0	0	1	23	28	11	0	5	9	11	4	2	11	30	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
PM 1-3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	1	2	0	0	0	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	2	0	1	1	0	1	0	0	0	1
PM 3-6	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	2	2	3	1	3	2	3	1	2	0	2	0	2	1	1	0	1	1	2	1	2	2	1	1	1	1	0	1	1	1
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	1	1	1	0	2	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
DEAD	1	0	2	0	2	2	1	0	1	0	1	0	0	4	0	0	1	3	2	0	0	0	4	2	1	0	0	0	1	2

	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
PC SEED	0	0	0	1	1	1	1	0	1	0	0	0	0	1	3	1	3	2	0	0	0	2	3	0	1	0	0	0	0	0
PM SEED	0	0	0	0	0	0	0	0	0	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	1	4	0	0	0	0	0	0	0	0	0	0	4	2	1	0	1	1	0	0	0	0	3	0	0	0	0	0
PM TRANS	30	27	20	21	58	0	0	0	0	37	21	41	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	5	7
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2
PM 1-3	0	0	1	1	1	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	3	2	0	0	2	1	2	1	2	1	1	1	1	0	0	0	0	3	2	1	0	2	0	0	0	0	0	0	1	2
PM 3-6	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	5	4	2	0	0	2	2	1	2	2	2	3	1	1	0	2	2	0	0	2	1	4	1	3	1	1	0	1	2
PM 6-9	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0
DEAD	0	1	0	0	0	1	0	2	1	1	0	1	0	1	1	1	2	0	0	1	2	0	3	3	0	1	0	0	3	0

	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
PC SEED	0	0	0	0	0	0	1	0	0	6	0	0	0	0	0	3	0	0	0	5	1	0	0	3	2	0	0	0	0	3
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	2	0	3	0	0	0	2	2
PM TRANS	28	23	17	3	0	24	23	0	22	41	22	31	9	15	9	1	31	7	0	0	0	2	14	0	0	0	0	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	2	2	1	0	0	1	0	0	0	0	0	1	0	0	2	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	3	1	1	2	1	2	2	2	3	2	1	1	1	0	2	1	1	2	0	0	0	1	2	1	1	1	0	2
PM 3-6	1	1	1	0	0	1	1	0	0	0	0	1	0	1	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	4	2	0	4	1	1	3	2	0	2	2	1	4	2	1	0	2	2	1	0	2	2	2	0	1	1	0	1	1	0
PM 6-9	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
DEAD	1	1	2	0	0	6	0	1	2	3	0	2	1	1	4	0	3	2	2	2	0	1	0	0	0	3	5	2	3	4

Table A-5. Continued (Whirlpool overstorey 1967).

	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
PC SEED	0	3	3	0	1	0	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	11	0	0	0	2	0	1	2	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	2	1	0	0	0	0	0	0	0	1	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
PM TRANS	0	0	0	0	0	0	1	7	17	14	0	1	22	9	4	35	31	27	8	33	0	22	25	0	0	0	17	12	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	2	0	0	1	1	0	0	0	1	2	0	1	3	1	2	0	0	1	3	0	0	1	0	1	0	2	1	1	0	3
PM 3-6	0	0	0	0	0	0	0	0	2	0	0	0	1	1	0	0	1	1	0	0	1	2	1	0	0	0	1	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	1	3	1	2	0	0	1	1	2	2	1	2	1	0	2	1	3	1	2	1	3	2	1	2	4	2	1	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	1	0	1	2	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	3	1	2	1	4	0	1	1	2	3	0	0	0	2	2	0	3	1	3	2	2	4	0	2	0	0	1	0	0	1

	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
PC SEED	0	2	1	1	0	0	1	1	2	0	0	1	2	1	1	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0
PM SEED	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	1	1	1	0	0	0	0	0	1	0	0	2	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0
PM TRANS	22	13	18	12	5	0	0	0	0	0	0	0	0	0	0	0	19	18	11	7	0	0	18	12	0	31	36	11	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PM 1-3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	2	0	0	0	0	1	2	1	1	0	0	1	2	1	0	0	0	1	2	0	0	1	0	0	0	1	0	0	0
PM 3-6	1	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	3	1
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	3	2	3	1	1	1	2	1	1	2	3	1	3	2	0	0	4	3	1	0	3	2	1	2	1	1	1	3	1	1
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PC 9-12	0	0	0	2	0	0	1	0	0	1	0	1	0	0	1	0	1	0	0	0	0	1	0	1	0	1	1	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	2	5	1	3	1	1	0	1	0	0	0	1	2	0	0	1	4	3	2	3	0	6	4	3	0	2	1	3	1

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
PC SEED	0	0	0	0	0	0	0	0	1	0	7	1	0	0	2	12	0	0	0	0	0	5	0	4	7	0	3	1	1	1
PM SEED	0	4	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	3	9	1	0	0	1	4	10	3	0	0	0	0	3	0	0	10	4	0	0	4	20
PM TRANS	23	37	14	16	8	0	0	19	10	9	0	17	6	15	1	0	0	0	0	0	0	0	3	13	1	1	7	25	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PM 1-3	1	1	1	3	1	0	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	2	1	1	1	1	0	0	1	0	1	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 3-6	0	0	1	3	1	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	3	2	2	1	2	2	2	0	0	1	2	3	1	1	0	1	1	1	2	2	0	1	0	1	0	1	0	0	0
PM 6-9	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	0	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1	1	3	0	3	0	0	1	3	1	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
DEAD	1	2	3	2	3	3	5	1	0	2	0	0	1	2	0	0	0	1	2	1	1	0	1	2	2	1	2	3	1	0

Table A-5. Continued (Whirlpool overstorey 1967).

	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
PC SEED	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	1	2	0	0	2	1	2	0
PM SEED	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	26	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	21	3	2	0	0	1	4	1	0	0	0
PM TRANS	0	0	17	4	17	0	0	4	0	17	8	10	28	12	17	28	20	0	0	1	0	0	0	34	9	0	0	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
AL TRANS	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
PM 1-3	0	0	0	0	2	0	1	0	0	1	0	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	1	0	0	3	0	0	2	2	1	1	1	1	0	0	0	0	2	0	2	0	0	0	0	0
PM 3-6	0	0	1	0	0	0	0	1	0	1	3	0	0	1	0	0	2	0	0	0	0	0	0	1	1	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	1	0	3	0	2	1	1	0	0	5	2	2	3	2	3	1	0	0	0	0	1	3	2	2	4	0	1	1
PM 6-9	0	0	0	0	0	0	0	0	3	0	1	1	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	2	0	0	2	0	0	1	2	0	0	0	0	0	0	1	2	0	1	2	0	0	1	1	0	1	1	1
PT 9-12	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
DEAD	1	0	0	0	0	2	5	4	2	0	0	1	0	1	2	0	0	0	0	0	0	0	0	1	1	1	2	0	2	2

	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
PC SEED	2	1	0	0	3	1	3	0	1	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	37	0	0	0	1	3	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	3	3	2	1	7	8	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
PM TRANS	0	0	0	0	0	0	26	0	1	0	0	2	0	24	33	17	5	7	6	10	21	5	3	4	6	18	8	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
AL TRANS	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	1	1	0	0	0	1	2	2	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	0	1	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	0	0	4	2	0	1	3	0	1	0	0	0
PM 3-6	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	2	0	2	2	2	1	0	1	1	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	1	1	3	2	2	0	0	0	1	0	2	5	1	2	3	2	1	5	1	0	3	2	2	1	0	0	1	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	2	0	1	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	1	0	0	1	0	0	1	0	0	1	1	1	0	0	0	0	0	1	0	0	1	1	0	0	1	1	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
DEAD	0	0	1	0	2	0	0	0	0	0	0	0	3	0	3	3	0	2	6	3	2	0	1	3	2	1	1	2	0	0

	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
PC SEED	0	0	1	0	0	2	2	1	0	0	0	1	1	0	0	1	0	1	1	3	0	1	2	0	0	0	0	0	0	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	6	0	0	5	0	0	0	1	0	0	0	0	2	0	1	0	0	3	3	0	0	1	5	5	0	0	0	0	0	0
PM TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	2	0	0	3	8	5	5	4	10	17
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PM 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	2	0	0	0	0	0	0	2	2	2	1	1	0
PM 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	2	0	1	1	0	3	4	3	1	1	2	1	0	1	0	2	0	0	1	1	0	0	4	2	2	1	2	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0
PT 6-9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	1	0	2	1	2	0	0	0	0	1	2	0	0	0	0	1	0	1	0	0	0	1	1	0	0	2
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	1	0	0	0	1	0	1	1	3	0	3	3	5	4	0	0	0	0	1	1	3	3	1	0	1

Table A-5. Continued (Whirlpool overstorey 1967).

	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	5	0	2	0	0	3	1	3	3	2	0	3	0	2
PM SEED	3	28	0	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	1	1	2	0	2	2	1	0	1	1	1	0	2	0	0	0	0	0	0	4	0	1	0	0
PM TRANS	8	8	8	18	14	36	10	0	24	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PM 1-3	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	0	2	1	0	0	1	0	1	0	0	1	1	0	0	1	0	2	0	0	2	2	0	0	0	0	0	1	1	1
PM 3-6	1	2	1	3	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	3	2	1	2	2	0	1	1	1	3	0	2	0	0	0	1	2	3	2	3	2	1	1	1	2	0	3	0	1	0
PM 6-9	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	1
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DEAD	0	2	2	0	2	1	2	1	0	0	1	2	1	2	1	2	1	1	1	1	0	1	1	0	1	0	1	0	1	1

	391	392	393	394	395	396	397	398	399	400
PC SEED	0	0	0	0	0	0	0	0	0	0
PM SEED	0	0	0	0	0	0	0	0	0	8
AL SEED	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0
PM TRANS	0	0	18	20	41	5	6	5	14	17
PG TRANS	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	0	1	0	1	0	0	0	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0
PT 1-3	0	0	0	0	0	0	0	0	0	0
PC 3-6	3	0	1	1	0	0	0	1	0	1
PM 3-6	0	0	1	1	2	0	2	0	2	1
PG 3-6	0	0	0	0	0	0	0	0	0	0
PT 3-6	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	1	0	0	1	2	1	1	0	2
PM 6-9	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	0	0	0	0	2	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	1	1	0	1	0	0	0	0	0
DEAD	1	0	0	0	0	0	1	0	4	0

Table A-6. Density of overstorey species by DBH class at Whirlpool in 1989.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PC SEED	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PM SEED	1	1	2	0	0	1	1	5	0	1	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	1	2	0	1	0	2	1	3	4	3	3	1	3	0	0	0	0	0	4	9	4	2	9	4	7	3
PM TRANS	11	12	14	4	4	20	12	4	14	9	5	0	0	0	0	0	9	3	1	14	5	3	12	6	0	0	0	6	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	2	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	1
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	1	1	1	2	0	1	0	0	5	1	2	0	0	0	0	0	2	0	0	0	2	1	6	0	0	0	0	1	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PM 3-6	0	1	0	1	1	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	2	0	1	3	2	2	2	2	0	0	0	0	0	0	1	0	0	0	3	1	0	2	1	0	1	0	0	0	1	0
PM 6-9	0	2	2	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	1	0	0	0	1	2	0	1	2	0	1	2	0	1	1	3	0	0	1	1	0	2	0	0	3	1
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	2	0	2	1	5	1	2	1	1	1	0	0	1	0	0	0	2	1	1	0	2	0	1	2	0	0	0	0	1	0

Table A-6. Continued (Whirlpool overstorey 1989).

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	3	1	1	0	0	0	0	2	0	0	0
PM SEED	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	1	0	0	3	0	4	3	1	0	0	0	0	1	0	0	1	1	1	4	6	12	13	5	0	5	0	1	0	1	1
PM TRANS	13	1	5	0	12	0	0	8	7	5	5	0	2	0	4	0	0	1	8	0	0	0	0	0	0	0	0	1	1	10
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0
AL TRANS	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	3	0	4	0	0	0	0	5	0	2	0	0	0	1	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	1	0	1	0	1	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0
PM 3-6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	1	2	1	2	0	1	1	1	0	1	1	1	1	0	2	2	1	1	1	1	1	0	0	0	0	0	1	1	0
PM 6-9	1	0	0	0	0	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	0	0	1	1	0	1	0	0	0	0	0	1	1	1	0	0	1	1	0	1	0	1	1	3	0	2	0	1	0
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	2	2	0	0	4	2	3	3	2	3	4	2	0	1	0	0	1	1	0	0	1	2	0	0	0	1	0	1	1

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
PC SEED	3	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	1	0	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0
PC TRANS	8	4	2	1	2	0	0	3	3	0	2	3	5	1	0	0	3	3	3	0	0	1	8	5	3	0	0	3	7	0
PM TRANS	0	1	0	1	0	0	0	0	0	3	0	0	0	0	1	14	0	1	14	13	13	1	2	0	8	6	7	5	3	11
PG TRANS	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	0	2	0	0	0	0	0	0	0	0	1	1	0	0	4	0	0	0	2	1	0	0	1	0	5	0	0	0	4
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
PM 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	1	0	0	1	0	1
PG 3-6	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	1	1	1	0	1	0	0	0	0	3	2	1	3	1	2	0	0	1	1	2	3	0	1	0	1	0	1	4	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	0	1	2	0	2	1	2	2	2	0	0	1	0	0	0	2	0	0	0	0	0	0	2	0	0	1	1	0	0
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	1	0	3	0	0	1	0	0	0	1	0	2	2	2	2	0	0	4	2	4	2	2	0	0	1	2	2	0	0

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PM SEED	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5	0	0	0	0	0	0	0	0	2	3
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	1	2	4	1	2	3	0	1	3	1	1	1	1	4	0	1	0	0	3	2	0	0	6	11	7	0	0
PM TRANS	16	10	4	5	6	1	0	0	0	0	3	0	0	2	0	0	0	3	16	19	13	0	4	1	8	5	3	6	13	16
PG TRANS	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
PT TRANS	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	3	2	2	2	5	1	0	0	0	0	0	0	0	0	0	0	0	1	2	2	3	0	1	1	1	1	5	1	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	1	0	0	0	0
PM 3-6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	0	0	0	0	0	0	3
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	2	0	2	0	1	0	0	1	2	0	0	0	0	0	0	0	0	1	3	0	0	1	1	0	0	0	0	2
PM 6-9	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	1	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	1	1	0	1	1	1	0	2	0
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	2	1	1	0	1	1	0	0	0	0

Table A-6. Continued (Whirlpool overstorey 1989).

	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
PC SEED	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	1	1	0	0	1	1	1	1	0	1	0	0	0
PM SEED	2	0	0	2	1	0	0	0	0	0	6	0	2	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	1	4
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	2	0	0	1	0	3	0	0	0	0	2	9	3	4	3	1	2	1	3	0	0	4	0	0	0	0	0
PM TRANS	27	23	12	10	16	1	0	0	0	17	18	12	9	7	1	0	1	0	0	0	0	0	0	0	0	0	0	12	6	18
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	3	2	5	6	7	0	0	0	0	5	4	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	3
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	1	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
PM 3-6	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	3	1	0	1	0	0	1	1	2	1	0	2	0	1	0	1	2	1	0	2	2	1	1	1	0	1	0	1	0
PM 6-9	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	2	1	0	1	2	2	0	0	0	1	0	1	1	1	0	0	0	0	0	1	0	0	1	1	1	0	0	0
PM 9-12	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	2	1	0	0	0	2	1	1	1	0	1	0	0	0	0	1	1	0	1	2	1	2	0	0	1	0	0	3	2

	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
PC SEED	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PM SEED	0	2	0	0	1	0	0	2	0	1	1	0	1	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	6	0	0	1	4	0	0	0	6	4	3	0	1	6	2
PM TRANS	3	7	11	2	4	8	4	2	12	34	12	5	5	9	16	2	15	0	0	0	8	4	15	0	0	0	0	1	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	1	4	7	1	1	5	1	0	2	2	0	1	0	3	1	0	2	0	0	0	1	0	5	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	1	1	0	0	0	1	1	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
PM 3-6	0	0	1	0	0	1	0	0	0	1	0	1	0	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	1	1	3	0	2	0	0	1	1	2	0	2	2	0	0	1	1	0	3	2	2	0	0	1	1	0	2	0	1
PM 6-9	1	2	1	0	0	1	1	0	1	2	1	1	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	2	1	0	0	0	0	0	2	0	2	0	1	0	0	1	2	0	0	1	1	1	0	0
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	2	2	1	5	1	1	2	2	1	0	3	3	1	0	0	0	1	0	1	0	0	1	2	1	2	2	1	3

	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
PC SEED	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PM SEED	0	0	0	0	0	2	0	0	2	1	0	0	0	1	1	0	1	0	4	0	2	2	0	1	1	0	0	0	0	1
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0
PC TRANS	0	2	5	1	3	0	1	0	1	0	3	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	1	2	4	2
PM TRANS	0	0	0	0	1	0	1	5	14	8	0	0	12	3	1	9	17	19	13	26	12	14	22	11	4	0	5	5	0	3
PG TRANS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	0	0	0	0	0	0	0	0	1	0	0	2	4	0	5	5	0	0	2	1	6	1	2	0	1	2	2	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 3-6	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
PM 3-6	0	0	0	0	0	0	0	0	3	2	0	0	0	1	0	2	1	0	0	1	0	0	1	0	0	0	1	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	1	2	1	1	0	0	1	0	1	1	0	1	1	0	1	2	3	1	0	0	1	1	0	1	1	1	1	0	1
PM 6-9	0	0	0	0	0	0	0	0	1	0	0	1	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	0	0	1	0	1	2	0	1	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	1	2	0	0	1	1
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	2	0	2	0	0	0	1	1	0	1	2	2	0	0	1	0	5	2	5	3	0	2	0	2	2	1	0	1

Table A-6. Continued (Whirlpool overstorey 1989).

	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
PC SEED	0	0	0	0	0	0	1	0	3	1	0	2	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
PM SEED	1	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	1	0	2
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	3	1	1	0	3	4	0	1	4	1	0	2	2	0	0	0	1	3	1	1	0	1	0	0	0	0	0
PM TRANS	16	11	11	6	5	1	0	0	0	0	0	0	0	0	0	0	1	0	11	0	0	0	4	2	5	4	21	10	0	3
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	1	1	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	6	0	1	2	0	3	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	1	0	0	0	0	1	0	1	1	0	0	1	1	0	0	0	0	0	1	0	1	1	1	0	0	1	1	0	0
PM 3-6	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	2	1	0	1	1	1	0	1	1	1	3	1	0	1	1	0	1	1	2	0	1	0	0	0	0	2	0	1
PM 6-9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	1	0	1	1	0	0	1	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	1	0	2	0	0	1	1	0	0	1	1	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PC 12-15	0	0	0	1	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	2	1	2	0	3	2	1	0	0	0	1	1	0	0	1	1	0	1	0	1	1	2	1	2	1	2	4	4

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
PC SEED	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	1	0	0	1	0	0	0	0	1	0	2	0	0	1	1
PM SEED	4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	2	2
PC TRANS	0	0	0	0	0	0	1	0	2	5	6	5	0	7	6	20	1	5	5	0	1	8	0	7	15	5	5	1	5	11
PM TRANS	14	19	8	10	2	0	1	4	4	4	0	12	0	12	0	0	1	0	0	0	0	0	0	9	0	0	1	11	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	0	1	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	1	1	1	1	0	0	5	5	4	0	0	2	3	0	0	1	0	0	0	0	0	1	3	1	0	1	1	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 3-6	0	0	0	3	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	3	0	2	0	0	1	2	0	0	0	0	2	1	0	0	0	0	0	3	3	0	3	0	0	0	3	0	0	1
PM 6-9	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	1	1	1	0	0	1	1	1	1	1	1	1	0	0	0	1	0	0	0	0	1	1	1	0	0
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	1	6	2	1	0	4	0	0	0	1	0	1	0	0	0	0	1	0	2	0	0	1	0	0	0	0	0	0	0

	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
PC SEED	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	1	2	0	2	0
PM SEED	0	0	0	0	0	0	0	1	0	3	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	1	0	0	0	0	0	0
PT SEED	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	1	0	0	0	0	0	0	0	0
PC TRANS	27	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	11	5	4	3	2	2	8	0	5	6	2
PM TRANS	0	0	16	3	11	0	0	2	11	11	7	6	5	4	7	10	8	0	0	0	0	0	0	6	9	0	0	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	1	0	0	1	0	0	0
PT TRANS	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	1	0	1	2	0	1	0	0	1	0	0	3	1	3	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PC 3-6	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 3-6	0	0	1	0	1	0	1	0	1	0	2	2	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	1	3	0	2	0	1	0	0	0	2	2	1	0	2	1	1	0	0	0	1	2	1	0	1	0	1	1
PM 6-9	0	0	0	0	0	0	0	0	3	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	0	0	1	1	1	0	1	0	0	1	0	1	0	1	1	0	0	1	1	0	1	1	1	1	0	1
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
PT 12-15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
DEAD	0	0	0	0	0	0	2	1	0	1	1	4	2	0	1	0	2	1	0	0	0	1	2	1	2	0	1	0	0	0

Table A-6. Continued (Whirlpool overstorey 1989).

	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
PC SEED	1	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
PM SEED	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	4	1	2	0	4	6	8	2	3	6	8	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	2
PM TRANS	1	0	0	0	0	0	2	0	0	0	0	0	0	19	10	10	4	4	15	3	13	5	2	6	1	3	5	0	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	0	0	0	0	0	3	0	0	0	0	0	0	1	6	2	0	0	0	0	0	0	0	0	0	2	4	0	0	0
PG 1-3	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PC 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PM 3-6	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	2	0	0	0	1	2	1	0	0	4	1	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	2	0	0	1	0	0	0	0	1	0	1	2	0	0	2	1	0	3	0	1	1	1	1	2	0	1	1	1
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	1	0	2	2	0	1	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	0	0	2	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	2	0	1	0	0	0
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	1	3	0	2	0	0	0	0	0	0	3	2	1	0	3	3	1	6	3	3	2	2	2	0	1	0	0

	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
PC SEED	1	0	0	0	0	0	1	2	0	0	0	0	1	0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0
PM SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	2	0	0	1	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
PC TRANS	1	2	1	10	1	1	6	1	0	1	0	0	9	2	0	2	1	2	2	1	1	2	9	1	0	0	0	0	0	0
PM TRANS	1	0	0	0	0	0	0	0	0	0	0	1	1	4	0	0	0	0	0	0	1	3	0	4	7	11	5	6	14	13
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	1	0	0	0	0	0	2	1	0	0	1	0	0	2	0	1	0	0	0	1	0	1	2	1	1	1	0	0
PM 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	2	0
PG 6-9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	0	0	1	0	0	0	0	1	0	1	2	0	0	0	0	1	1	0	0	0	3	0	0	1	1	1
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	1	0	2	1	0	2	0	0	1	0	0	0	0	1	3	2	2	0	0	0	0	1	2	1	0	3	1	0

	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
PC SEED	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0
PM SEED	3	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT SEED	0	0	0	0	2	1	0	0	1	0	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	1	0	2	2	1
PC TRANS	0	0	0	0	0	0	0	1	0	3	3	4	5	2	3	4	6	1	4	2	1	2	2	1	0	6	0	0	1	1
PM TRANS	9	20	4	11	13	18	8	0	7	9	2	0	2	0	0	0	1	0	0	0	0	0	2	0	0	0	0	1	0	0
PG TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL TRANS	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PT TRANS	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0
PC 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PM 1-3	0	0	0	0	0	1	0	0	7	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PC 3-6	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	3	1	0	0	0	0	0	0	0	0
PM 3-6	0	0	0	3	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	1	2	0	0	0	0	1	1	0	0	1	1	0	0	0	0	3	0	2	1	2	0	1	1	0	1	0	0	1
PM 6-9	1	1	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	0	1	0	0	0	0	1	0	2	0	0	0	0	0	0	2	0	2	1	1	0	1	0	0	0	1	0	0	1
PM 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PT 12-15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	1	2	1	1	0	2	1	1	0	1	1	1	0	2	1	1	1	1	0	1	1	0	0	0	0	1	0	0

Table A-6. Continued (Whirlpool overstorey 1989).

	391	392	393	394	395	396	397	398	399	400
PC SEED	0	0	0	0	0	1	0	0	0	0
PM SEED	0	0	0	0	0	1	0	0	0	1
PG SEED	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0
PT SEED	1	0	0	0	0	0	0	0	0	0
PC TRANS	2	0	0	0	0	0	0	0	0	0
PM TRANS	0	0	8	9	15	4	5	8	8	15
PG TRANS	0	0	0	0	0	0	0	0	0	0
AL TRANS	0	0	0	0	0	1	0	0	0	0
PT TRANS	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	0	5	0	0	0
PM 1-3	0	0	3	1	2	0	0	3	0	1
PG 1-3	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	0	0	0	0	0	0	0
PM 3-6	0	0	1	0	2	0	0	0	0	1
PG 3-6	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0
PC 6-9	2	0	0	0	0	1	0	0	1	2
PM 6-9	0	0	1	1	0	0	2	0	1	1
PG 6-9	0	0	0	0	0	0	0	0	0	0
PT 6-9	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	0	1	1	1	0	1
PM 9-12	0	0	0	0	0	0	0	0	0	0
PT 9-12	0	0	0	0	0	0	0	0	0	0
PC 12-15	0	1	0	0	0	0	0	0	0	0
PT 12-15	0	0	0	0	0	0	0	0	0	0
PC 15-18	0	0	0	0	0	0	0	0	0	0
DEAD	2	1	1	0	2	0	1	0	1	0

Table A-7. Density of overstorey species by DBH class at Hector in 1967.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PC SEED	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	1	0	0	1	4	3	1	5	2	0	1	2	1	0	1	1	1	0	2	0	2	3	1	1	4	4	3	2	0
AL SEED	0	0	0	0	1	0	1	1	2	0	0	0	0	0	0	0	0	0	2	0	0	5	0	1	0	1	2	0	0	0
PC TRANS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	1	0	0	22	13	25	15	17	11	7	11	11	10	2	4	5	6	5	8	6	6	1	9	6	22	4	13	12	12	5
AL TRANS	3	9	0	6	3	7	4	1	0	1	0	0	5	0	1	1	0	1	0	2	0	1	7	3	2	2	3	3	1	0
PC 1-3	0	1	0	0	0	1	3	4	3	1	1	3	2	3	0	0	2	2	2	3	0	0	2	5	3	0	6	1	0	1
PG 1-3	3	1	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	2	0	1
AL 1-3	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	0	4	2	5	5	1	4	1	1	7	13	3	1	6	7	3	9	6	3	0	4	6	4	0	4	3	1	0
PG 3-6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	0	1	3	0	3	0	1	0	1	0	2	4	1	1	2	2	0	0	2	1	0	0	2	1	2	1	1
PG 6-9	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	3	1	0	0	1	0	0	0	0	1	0	0	0	1	0

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
PC SEED	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	2	1	1	0	0	0	4	0	0	0	0	0
AL SEED	0	0	0	3	0	0	1	1	4	3	5	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	5	5	5	9	15	10	24	12	1	0	0	2	27	12	10	13	3	8	5	17	7	10	10	4	7	7	2	2	8	13
AL TRANS	2	3	0	4	2	7	5	6	1	26	9	4	5	0	4	3	0	1	2	1	0	0	1	0	3	1	0	0	1	0
PC 1-3	2	3	1	0	1	0	0	5	0	0	0	5	4	5	2	0	2	1	2	2	1	1	1	2	3	6	3	1	1	2
PG 1-3	1	1	0	0	4	0	2	0	0	0	0	0	2	0	1	2	0	1	0	0	0	0	1	0	1	0	0	1	0	1
AL 1-3	0	0	0	0	0	0	1	0	0	2	4	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PC 3-6	7	5	2	5	3	0	5	3	0	0	0	0	7	4	1	3	5	1	5	4	7	1	4	6	9	9	10	2	4	5
PG 3-6	0	0	0	0	0	0	0	0	1	0	3	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	0	3	2	0	1	0	0	0	1	1	0	0	1	1	2	1	1	0	1	1	1	1	0	0	0	2	1	1
PG 6-9	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0	0	2	0	0

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	1	0	0	0	0	0	2	0	1	2	3	1	0	5	3	0	1	6	2	0	0	0	1	0	2	1	2	2	0	1
AL SEED	0	0	0	0	1	0	1	0	1	0	0	0	0	0	4	1	1	1	0	3	0	1	1	0	0	0	0	1	0	0
PC TRANS	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
PG TRANS	15	6	6	3	3	8	5	8	8	11	12	3	3	6	9	8	13	9	6	0	3	6	12	13	24	8	2	8	5	10
AL TRANS	0	1	0	1	0	0	0	0	0	1	2	3	1	1	2	3	8	8	2	4	3	4	4	8	9	7	0	1	1	2
PC 1-3	1	0	2	1	7	2	1	0	3	0	2	3	1	1	0	2	3	7	6	2	3	2	4	3	0	1	1	2	2	3
PG 1-3	2	0	0	1	0	0	0	0	3	3	1	1	1	1	0	1	0	1	0	0	3	1	0	0	1	1	1	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	1	0	0	3	0	1	0	0	0	0	0	0
PC 3-6	3	7	12	6	7	6	2	4	3	4	3	4	2	2	6	3	3	7	4	5	6	6	9	6	4	2	5	5	7	5
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	2	1	0	0	0	2	2	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	0	0	3	1	1	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	2	3

Table A-7. Continued (Hector overstorey 1967).

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	2	0	1	0	1	1	0	0	3	1	0	1	0	0	0	2	1	1	0	0	0	0	0	0	2	0	1	0
AL SEED	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	1	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	3	5	4	12	13	13	3	5	2	5	10	9	5	4	11	9	7	10	6	5	3	3	1	3	8	13	7	8	3	0
AL TRANS	2	1	1	0	1	2	0	0	0	2	1	0	1	1	0	0	0	2	3	1	1	1	2	1	2	6	2	7	4	0
PC 1-3	0	2	0	1	5	6	2	2	1	1	6	4	4	4	3	3	3	9	2	3	1	1	3	2	2	3	1	2	3	5
PG 1-3	0	0	2	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	2	0	0	5	3	0	2
AL 1-3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
PC 3-6	10	3	6	3	8	8	5	6	3	3	6	6	5	5	4	6	9	9	6	4	10	9	5	7	5	6	8	2	6	4
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	3	1	0	0	2	0	0	2	1	0	0	0	1	1	1	0	0	0	1	0	0	0	1	2	0	0	0	2	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	5	1	0	1	0	0	0	0	0

	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PG SEED	4	2	0	0	1	4	4	0	0	0	1	2	0	0	3	2	1	6	3	0	0	1	2	1	0	0	0	0	0	0
AL SEED	0	0	4	0	1	1	1	1	0	0	0	0	0	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	2	2	7	3	9	9	8	4	6	9	2	7	5	4	3	4	9	13	6	6	1	5	4	5	5	0	3	1	4	2
AL TRANS	2	7	13	9	8	4	3	5	3	1	1	2	0	1	0	1	2	0	1	1	0	1	1	0	0	0	0	0	1	0
PC 1-3	0	2	3	1	2	1	0	2	2	2	2	7	2	3	1	1	4	6	8	5	2	3	3	3	1	2	1	3	3	4
PG 1-3	2	0	0	1	0	2	1	3	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
PC 3-6	4	5	4	2	4	4	5	2	3	1	11	10	6	7	5	5	6	5	10	8	8	6	4	5	1	6	5	2	7	8
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	3	1	0	1	0	1	0	2	0	0	0	0	1	1	0	0	1	0	1	1	3	1	2	4	3	0	0	3
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	1	1	0	0	1	0	0	1	2	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0

	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
PC SEED	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PG SEED	2	2	1	1	0	4	0	3	0	0	0	1	2	0	0	2	0	0	0	1	0	1	0	0	0	0	0	0	0	0
AL SEED	0	0	0	0	2	1	0	2	1	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	2	2	7	4	10	6	9	8	3	4	4	3	10	3	7	6	3	7	5	13	1	0	1	1	3	1	6	9	7	0
AL TRANS	1	0	1	1	0	3	2	9	7	3	0	5	4	3	0	1	1	0	0	2	0	0	0	0	0	0	1	0	0	1
PC 1-3	2	0	1	1	1	0	3	1	0	2	3	1	1	0	2	2	1	1	2	3	0	1	1	2	3	2	2	1	4	6
PG 1-3	0	1	0	0	4	0	0	1	2	1	1	2	3	0	1	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0
AL 1-3	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	5	5	4	1	1	1	3	5	5	5	1	8	3	3	2	10	0	1	3	4	3	5	6	2	3	0	2	5	9	3
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	1	0	1	2	2	0	0	0	0	1	2	0	2	0	3	2	3	0	2	0	2	2	1	0	2	3	1	1	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	2	0	0	0	2	2	0	0	0	3	0	0	0	0	4	0	6	1	0	0	0	1	4	1	0	1	1	2	2	2
AL SEED	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	4	0	0	0	0	1	1	0	0	0	0	0	0	2	1
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	0	5	2	3	2	0	0	3	4	5	3	3	5	4	3	4	10	6	7	2	3	2	2	1	3	3	5	6	7	8
AL TRANS	0	0	0	0	0	0	1	0	0	2	0	0	2	2	1	3	3	3	0	1	2	5	3	2	1	2	1	2	3	0
PC 1-3	2	2	2	2	0	6	4	3	2	2	1	1	2	0	1	3	1	0	1	0	0	0	2	0	1	1	3	2	5	2
PG 1-3	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	1	2	2	1	0	0	0	0	0	0	1	1	1	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	6	7	5	6	8	6	6	0	7	5	4	1	5	2	5	5	3	3	1	0	2	1	4	9	2	2	3	5	6	5
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	1	2	1	1	2	2	2	1	1	1	2	1	2	1	1	1	1	2	2	3	2	0	1	3	2	1	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0

Table A-7. Continued (Hector overstorey 1967).

	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
PC SEED	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PG SEED	0	1	0	0	0	0	0	1	1	0	1	0	1	0	3	0	0	0	3	2	5	0	4	0	0	0	2	0	0	0
AL SEED	0	0	4	0	0	1	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	4	1	1	1	0	7	4	1	0	1	3	2	0	1	3	3	2	2	7	3	8	3	4	4	3	4	9	5	1	0
AL TRANS	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	3	1	1	0	1	2	1	3
PC 1-3	2	0	1	1	1	4	2	5	3	0	0	4	0	2	5	4	2	1	1	2	4	6	3	3	2	4	3	1	0	3
PG 1-3	2	1	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	6	0	0	0	1
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PC 3-6	4	0	3	1	7	6	2	11	10	9	2	4	4	4	4	11	6	3	6	7	4	10	6	2	7	8	6	2	0	2
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	1	1	1	3	0	2	0	1	2	4	1	4	1	0	0	0	1	3	2	0	0	3	3	2	2	2	0	1	2
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	1	0	2	0	0	2	0	2	0	0	0	1	0	0	0	2	0	1	1	1	1	0	0	0	0

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	2	0	1	2	0	0	0	1	2	0	0	1	1	1	2	0	1	0	2	0	1	0	1	2	0	0
AL SEED	0	0	0	0	0	2	1	0	0	0	0	0	2	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
PG TRANS	2	1	2	5	12	1	2	2	3	1	0	1	0	3	1	1	2	2	1	1	3	4	5	5	3	2	5	1	0	1
AL TRANS	0	2	0	2	2	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 1-3	1	0	0	1	5	3	2	1	7	0	0	2	3	2	4	3	3	3	2	0	2	1	4	4	6	4	1	4	1	4
PG 1-3	0	0	2	4	2	3	0	0	0	0	3	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	2	3	2	1	4	2	5	6	7	4	4	5	6	4	8	9	6	6	0	3	5	6	4	8	10	4	3	7	2	5
PG 3-6	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	2	0	3	3	2	2	2	2	4	1	0	2	2	0	0	2	1	4	2	1	1	0	1	1	2	1	2	1	2
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	3	2	2	3	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0

	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	1	0	0	1	0	0	0	1	0	4	1	0	0	3	1	0	0	0	0	0	0	1	1	0	1	1	0
AL SEED	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
PG TRANS	2	3	0	1	0	2	4	4	2	1	1	0	2	0	1	1	2	1	0	1	0	0	2	3	3	1	1	3	0	0
AL TRANS	0	0	0	0	0	3	2	0	2	0	0	0	0	0	0	2	0	0	0	0	1	0	1	0	0	0	1	0	1	0
PC 1-3	3	5	5	2	3	2	5	1	1	1	2	3	1	2	2	4	4	10	5	3	6	1	5	3	3	6	13	10	3	14
PG 1-3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	3	6	5	6	3	2	3	8	2	0	3	3	7	3	3	2	3	8	9	2	2	4	6	3	3	4	8	4	5	11
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	1	2	0	0	2	2	3	3	2	1	0	3	0	5	0	2	0	0	3	0	5	3	4	1	2	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	1	3

- Set the VEB's index load register to initialize the VEB's joint encoder counter for the specified joint to the value pointed to by the *ioctl() arg* parameter.
- Check the specified joint encoder counter for receipt of an index pulse.

The specifics on using the VEB device driver may be found by examining the header file *veb.h* listed in Volume 2. Details on the construction and operation of the VEB may be found in [Kru90].

5.7 Description of Executable Files

The compiled MRC software is divided into three different executable files. The User Interface task is compiled into its own SunOS executable for execution on the host workstation. This project uses a User Interface compiled under the filename *textcontrol*.

The control modules are linked with the compiled controller stub (*controller.o*) into the *controller* executable that runs on the 'servo' RTPU. The only function of the stub is to start the servo server for use by the Robot Manager software executing on the 'master' RTPU. When the user wishes to change control modules, the *controller* executable must be re-linked with the new control modules.

The remainder of the tasks, (the Robot Manager, the Motion Generator, and the Data Logger) are compiled into the *robotman* executable and run on the 'master' RTPU. This executable, along with the User Interface, should seldom need to be re-compiled for most uses of the controller.

Please refer to the Software User's Manual in Volume 2 for more detailed instructions on compiling and running a controller setup.

Chapter 6

Results

6.1 Introduction

The results obtained for this project consists of timing information obtained for the controller library functions, and tests performed with a PID control algorithm implemented on the research platform. The timing information may be used in estimating the maximum achievable sampling rate for any particular control algorithm. The PID control algorithm, although tuned only in a preliminary fashion, demonstrates the usefulness of the controller as a research platform.

6.2 Timing and Testing of Libraries and Device Drivers

In order estimate the execution time of any particular control algorithm implemented with the system it is necessary to obtain accurate timing information about the operations that might compose a control algorithm. This informa-

Function	Operation	Representation	Execution Time
adcRead()	Pot-voltage read	Two's Complement	102.8598 μsec
		Floating Point (Volts)	186.9828 μsec
	Motor current read	Two's Complement	96.8364 μsec
		Floating Point (Volts)	140.6466 μsec
dacWrite()	Voltage Write	Two's Complement	71.142 μsec
		Floating Point (Volts)	225.5265 μsec
encRead()	Joint Angle Read	Integer Count	89.5521 μsec
		Floating Point (Rads)	160.0083 μsec

Table 6.3: Execution times for time-critical functions.

tion may then be used to *estimate* the execution speed of an algorithm and aid in optimizing the algorithm's execution speed by careful choice of the operations used. The estimated execution speed may then be used to arrive at an intelligent choice of an initial rate of execution for the completed controller.

Execution times for addition, subtraction, multiplication, division, and selected trigonometric operations are given in [Stea]. The execution times for the time-critical functions written as part of this project are determined experimentally. Each function is timed by executing it one million times in a *for()* loop. The average time of the one million iterations is then taken as the average execution time of the function.

As each of the time-critical functions is an input or output function to a virtual device, the timing operations were carried out for the default virtual devices (six inputs for the pot voltages, three inputs for the joint motor currents, six inputs for the joint encoder counters, and six outputs for the D/A converter). This is the standard controller I/O port configuration for controlling the PUMA 560 using the current hardware platform. The estimated execution time for each function using the default logical devices is given in Table 6.3.

6.3 Implementation of the PID Control Algorithm

The PID (Proportional Integral, and Derivative) controller for this project is implemented using the following discrete-time PID control transfer function found in [FPW90] with a negative multiplicative factor to compensate for the signal inversion at the Puma Interface Board [Kru90]:

$$\frac{U(z)}{E(z)} = -K_P\left(1 + \frac{Tz}{T_I(z-1)} + \frac{T_D(z-1)}{Tz}\right) \tag{6.1}$$

Where $U(z)$ and $E(z)$ are the discrete-time control voltage and error signal, respectively. The adjustable gains are K_P , T_I, and T_D. The sampling time of the control algorithm is T.

In order to increase the efficiency of this algorithm in its final implementation, the equation is rewritten to improve its performance. First, the proportional gain is multiplied through the function and all of the constants gathered together under three gains, K_P, K_I, and K_D. This reduces the number of multiplications and divisions that must be performed for each iteration of the controller. The sampling time T of the controller is not factored into the controller gains.

$$\begin{aligned} \frac{U(z)}{E(z)} &= -K_P - K_I\frac{Tz}{(z-1)} - K_D\frac{(z-1)}{Tz} && (6.2)\\ K_I &= \frac{K_P}{T_I} && (6.3)\\ K_D &= K_P T_D && (6.4) \end{aligned}$$

The controller transfer function may be converted to the difference equation:

$$\begin{aligned} u(k) &= u(k-1) - (K_P + K_I T + \frac{K_D}{T})e(k) + (K_P + 2\frac{K_D}{T})e(k-1) - \\ &\quad \frac{K_D}{T}e(k-2) \end{aligned} \tag{6.5}$$

Where the error signal is $e(k) = r(k) - c(k)$, $c(k)$ is the plant output, and $r(k)$ is the setpoint.

The implementation of this in the controller servo module would be of the form (disregarding the encoder sampling and control voltage output operations):

$$e(k) = r(k) - c(k) \tag{6.6}$$

$$\begin{aligned} u(k) &= u(k-1) - (K_P + K_I T + \frac{K_D}{T})e(k) + (K_P + 2\frac{K_D}{T})e(k-1) - \\ &\quad \frac{K_D}{T}e(k-2) \end{aligned} \tag{6.7}$$

$$u(k-1) = u(k) \tag{6.8}$$

$$e(k-2) = e(k-1) \tag{6.9}$$

$$e(k-1) = e(k) \tag{6.10}$$

This implementation involves four additions, three subtractions, five multiplications, three divisions, and five assignments of variables to memory locations. Using the arithmetic operation times supplied by Carnegie Mellon University, along with the measured times for this project's input and output routines, it is possible to estimate that the execution time for this implementation in a six-joint control situation is 1225 μsec.

This may be improved upon by rearranging the control algorithm to require fewer addition, multiplication, and division operations as follows:

$$
\begin{aligned}
e(k) &= r(k) - c(k) && (6.11)\\
\Delta e(k) &= e(k) - e(k-1) && (6.12)\\
u(k) &= u(k-1) - K_P \Delta e(k) - K_I T e(k) - \frac{K_D}{T}(\Delta e(k) - \\
&\quad \Delta e(k-1)) && (6.13)\\
u(k-1) &= u(k) && (6.14)\\
e(k-1) &= e(k) && (6.15)\\
\Delta e(k-1) &= \Delta e(k) && (6.16)
\end{aligned}
$$

In this case, six subtractions, four multiplications, one division, and six assignments of variables to memory locations were required. Using the same data as above, the estimated execution time for this algorithm is about 996 μsec for a six-joint controller.

The second implementation method is used for the demonstration PID controller. It was estimated that a sampling period of about 1.2 msec would be adequate for the control algorithm. However, it was found that a 1.2 msec sampling period was not satisfactory, as the controller process began missing deadlines. The sampling period was increased to 1.65 msec and satisfactory operation was obtained. This sampling period was used for the remainder of the tests for a sampling rate of 606.061 Hz.

The disparity between estimated maximum sample rate, and the actual maximum sampling rate could be attributed to ignoring the overhead incurred by other operations in the control loop besides the control calculation (i.e. controller output limiting, and error signal monitoring), Chimera II context switching (roughly 66 μsec), and the overhead of the servo task manager to which the control module is linked. The estimated maximum sample rate is useful only as a starting point for choosing a more appropriate sampling rate.

This control module employs output limiting and instability monitoring in order to provide increased system safety. The output of the control algorithm is limited to just within the maximum positive and negative values achievable by the D/A converter. This will prevent the controller from producing control signals too large to be sent from the D/A converter.

The instability monitoring operates by observing the error signal $e(k)$. If this signal exceeds a pre-set limit (the definition of this limit may be found in the *globalPUMA.h* header file, listed in Volume 2), the robot is immediately shut down. This is useful in the detection and safe handling of accidental instability during tuning the PID controller.

6.3.1 Tuning the PID Controller

Initially, tuning of the controller was attempted using the Zeigler-Nichols Ultimate Sensitivity method. This method hinges on the assumption that a closed-loop system with a simple proportional controller may be driven to steady oscillations at some critical gain value. The gain of the controller is increased until the system exhibits a sustained oscillation. The gain at this point, and the period of the oscillations, are used in rule-of-thumb calculations to determine the three controller gains, K_P, K_I, and K_D [FPW90].

It was quickly found that this method does not yield satisfactory results for this particular system. As the gain was increased to the critical value, the system did indeed become unstable, however it did not exhibit the expected sustained oscillation. Note that it was necessary to remove the error signal monitoring feature for this tuning method.

The tuning of the controller was therefore accomplished by a trial and error

Gain	PUMA Joint					
	1	2	3	4	5	6
K_P	130	135	75	110	50	70
K_I	25	175	140	200	90	100
K_D	0.4	0.4	0.35	0.1	0.1	0.1

Table 6.4: Gains for the PID controller

method. With the K_I and K_D gains set to zero, the K_P for each joint in turn was increased until overshoot to a step response of 1° was noted. The K_I and the K_D gains, in that order, were then set in the same manner.

The values thereby obtained were then used as a *starting point* for the optimization of the controller for performance with the motion generator. The speed of the motion was set to maximum, and the joint in question was moved through a trajectory which would take it through most of its range of motion (in this case, all joints were rotated through 180°).

This motion was sampled using the data logger, and with the help of the MRC's built-in support for graphics plots on an X-Window display, the controller gains were adjusted until a smooth motion was obtained. The K_D gain was increased to increase the speed of response to the changing setpoints, the K_I gain was increased to decrease the steady state error, and K_P was increased to increase joint stiffness.

The gains obtained via this method are presented in Table 6.4. Note that convention dictates that the PUMA's joints are labeled 1 – 6, as in Table 6.4. However the robot controller software requires that all indices into arrays begin from 0, therefore the gains are actually entered into the user interface indexed from 0 – 5.

Note that this control module was tuned to demonstrate the feasibility of the controller for use as a test platform for robot control algorithms. These gains are preliminary in nature, and further work could be done to improve joint stiffness and response to motions at high speed.

6.4 Tracking Performance of PID Control Algorithm

In order to examine the behavior of the selected control algorithm under typical robotic operating conditions, the tracking ability of the controller for the PID control algorithm was investigated.

It is desired that the controller be able to track the series of setpoints sent to it by the motion generator. These setpoints describe the motion of the robot manipulator through space. The tests performed to explore this situation involve moving the robot manipulator through a selected trajectory, and examining the ability of the controller to move the manipulator along the path specified by the motion generator algorithm.

In this case, the motion range for each joint was set to a path 180° long. The joint speed was set to a speed factor of 0.5, or 50% of maximum. The plots showing the tracking of each of the six joints using the obtained PID controller gains can be found on the following pages. Along with each plot of joint tracking is a plot showing the output of the controller (in volts) to indicate the control effort applied during a typical joint motion of the same magnitude and speed factor.

The controller outputs are recorded during different joint motion runs than the accompanying tracking responses. All factors (angular distance traversed and speed factor) were maintained between the tracking runs and the controller output runs. Repetitive runs of the controller output tests yielded identical results, therefore this method of logging was chosen for ease of recording.

The motions obtained for these setpoint tracking tests are obtained by performing each joint motion with the remaining PUMA joints motionless. These results do not accurately reflect the controller's performance in cases where dynamic coupling between joints inserts disturbances into the control loops, such as is the case when more than one of the major joints are moving simultaneously. This is especially noticeable in the case of simultaneous joint movements at higher speeds.

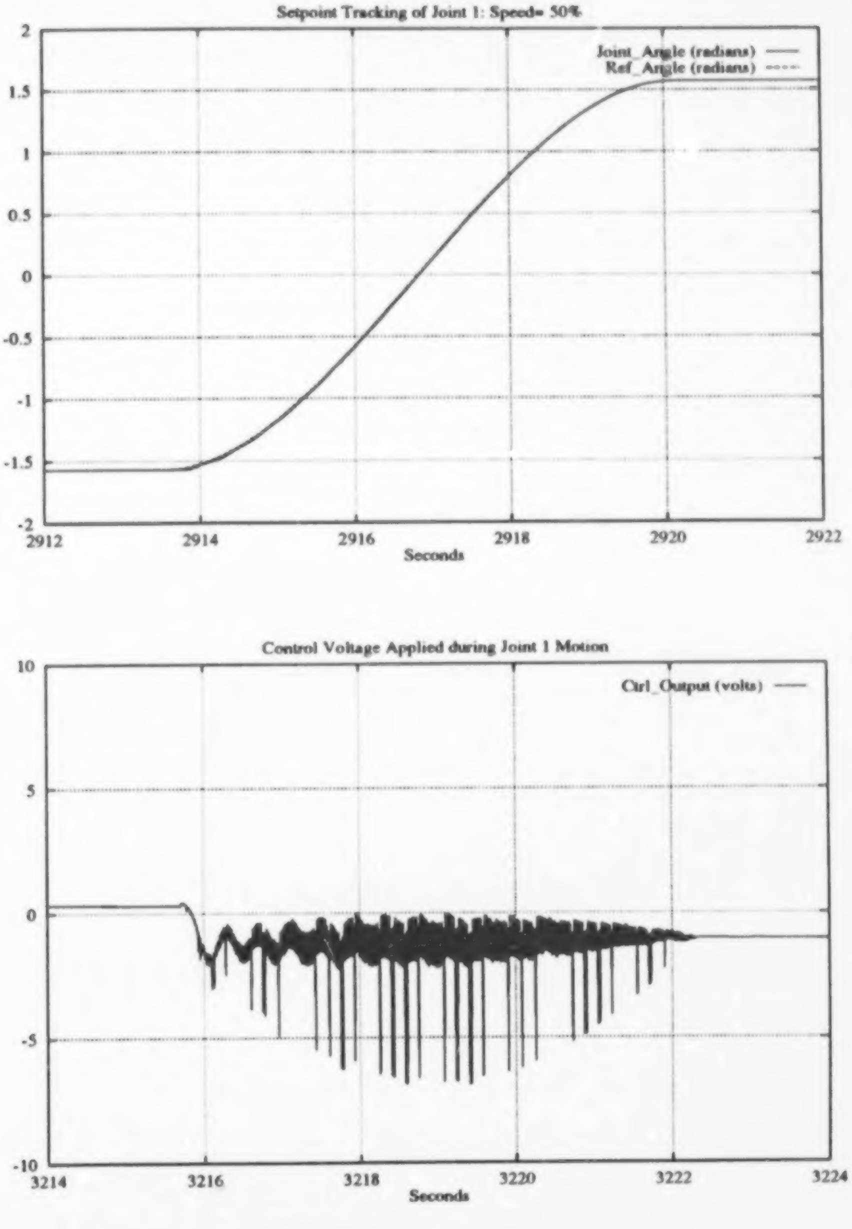

Figure 9: Joint 1 Motion and Control Signal at 50% speed

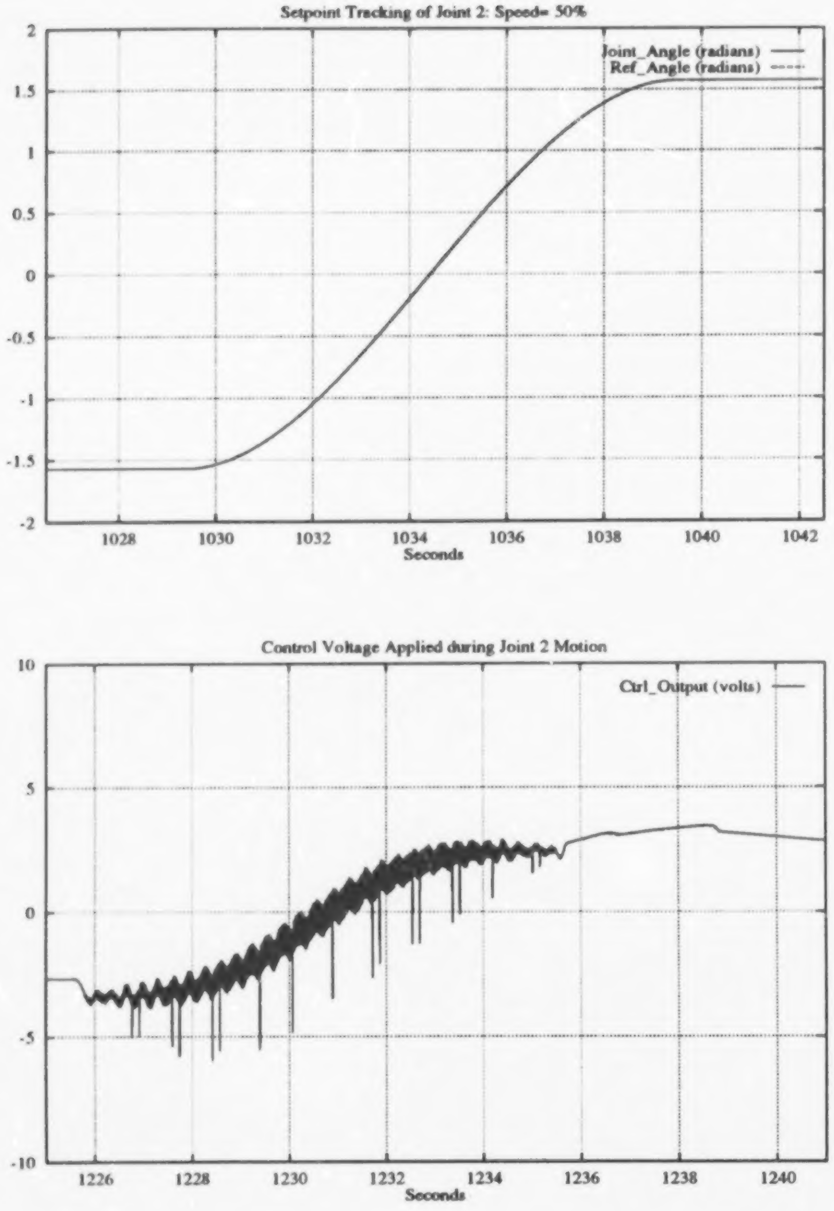

Figure 10: Joint 2 Motion and Control Signal at 50% speed

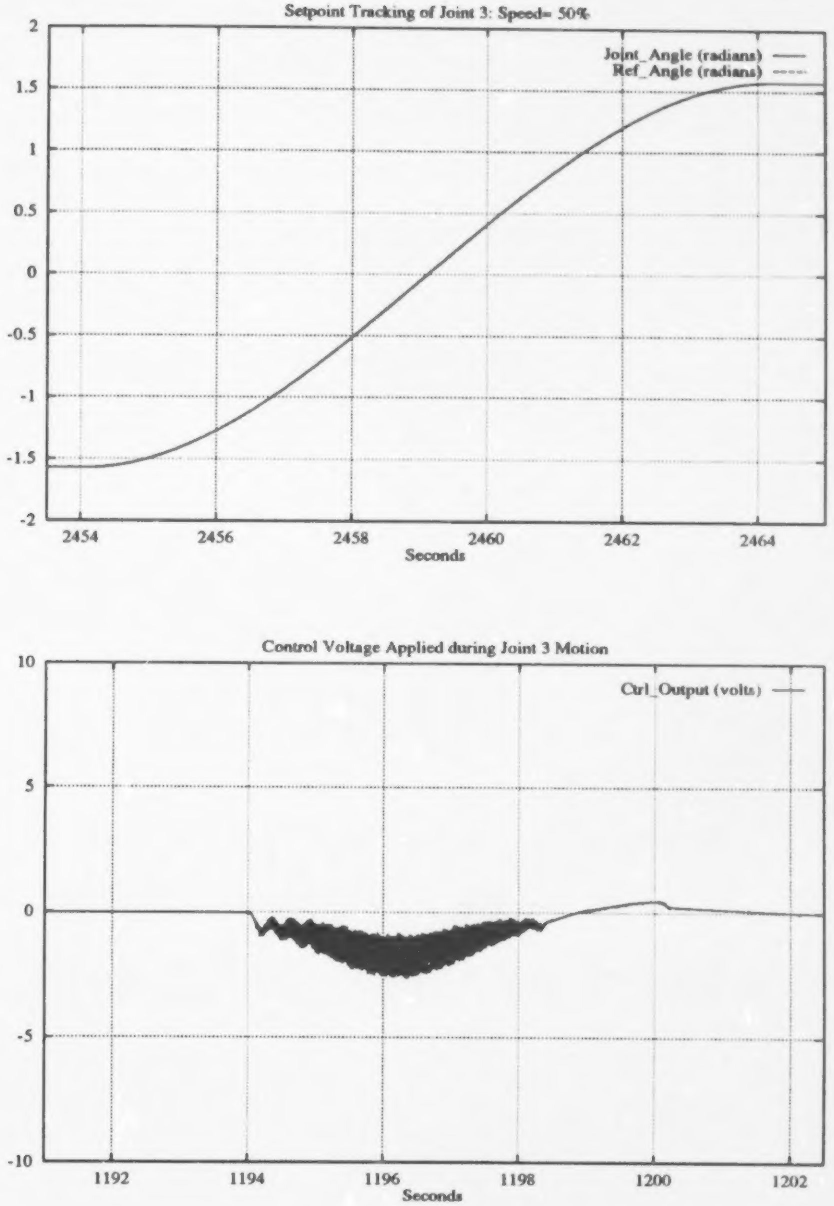

Figure 11: Joint 3 Motion and Control Signal at 50% speed

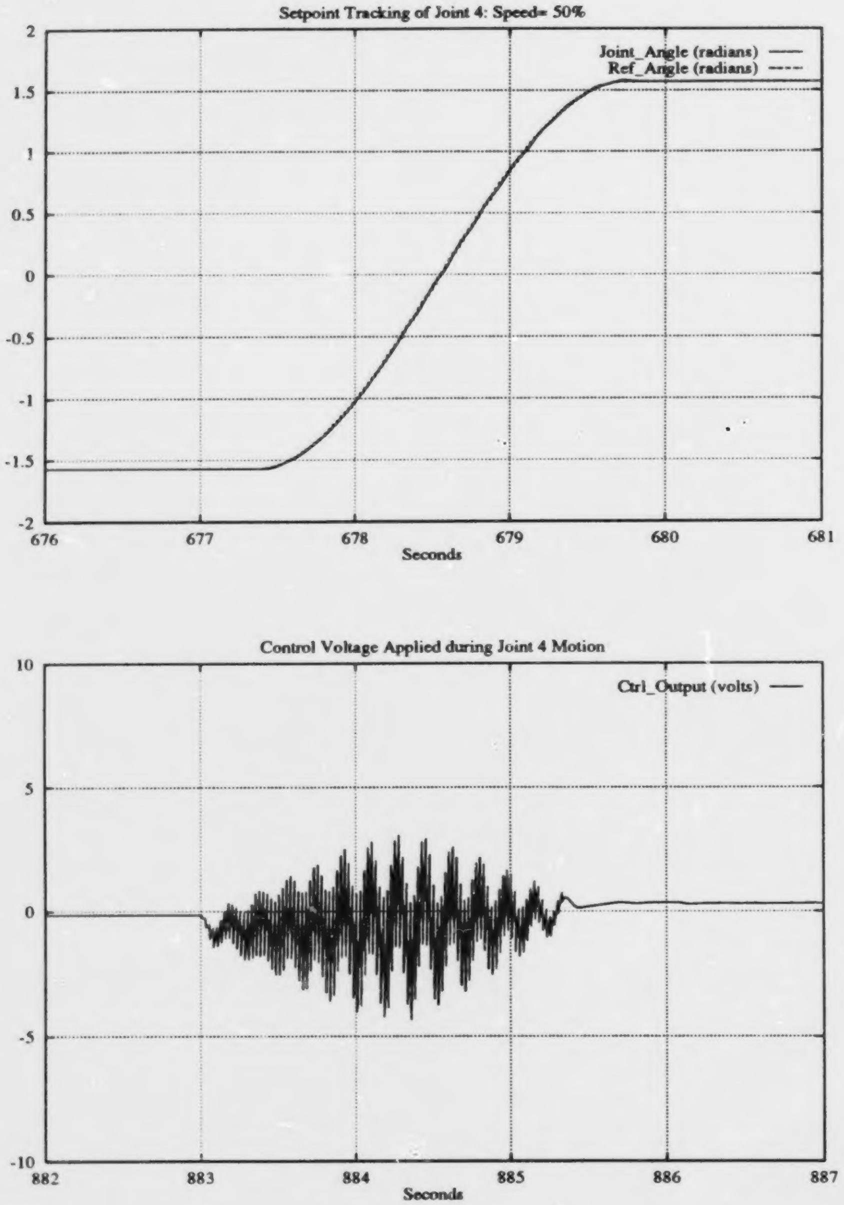

Figure 12: Joint 4 Motion and Control Signal at 50% speed

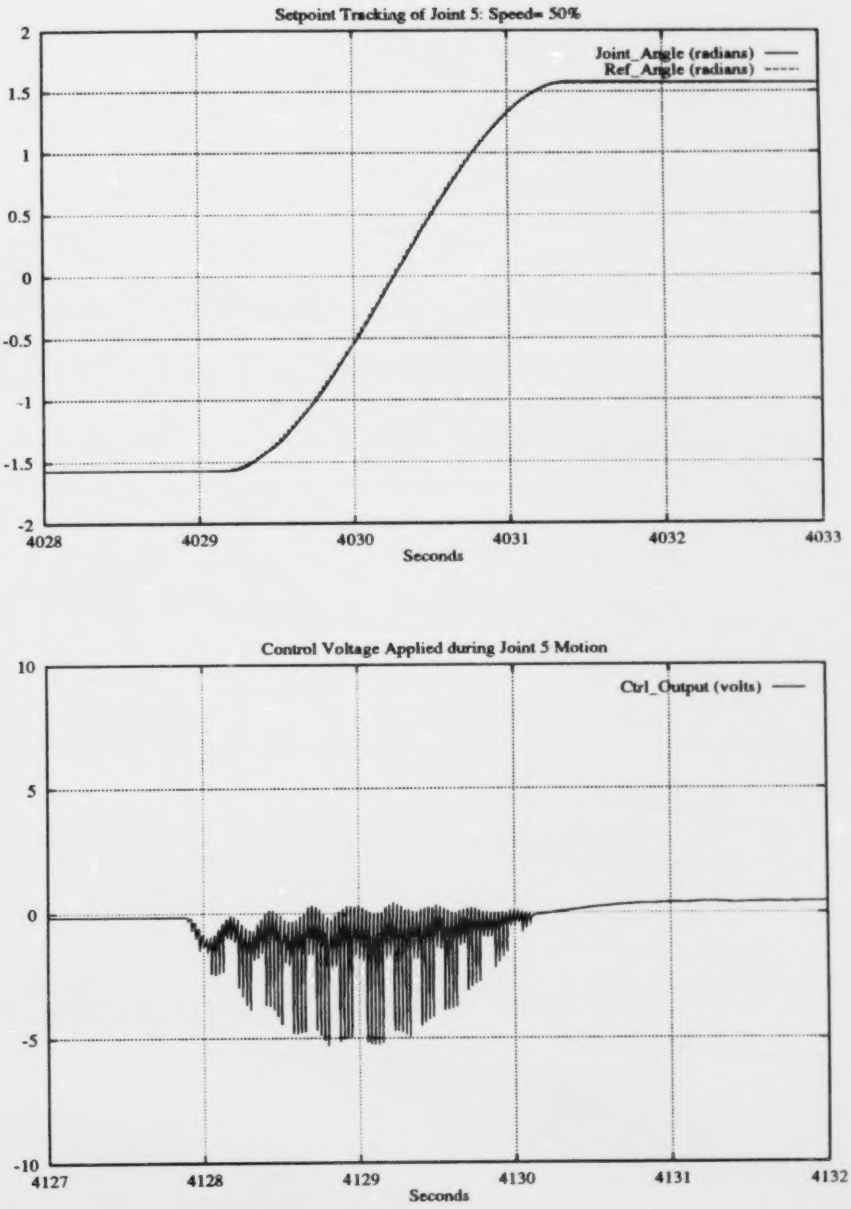

Figure 13: Joint 5 Motion and Control Signal at 50% speed

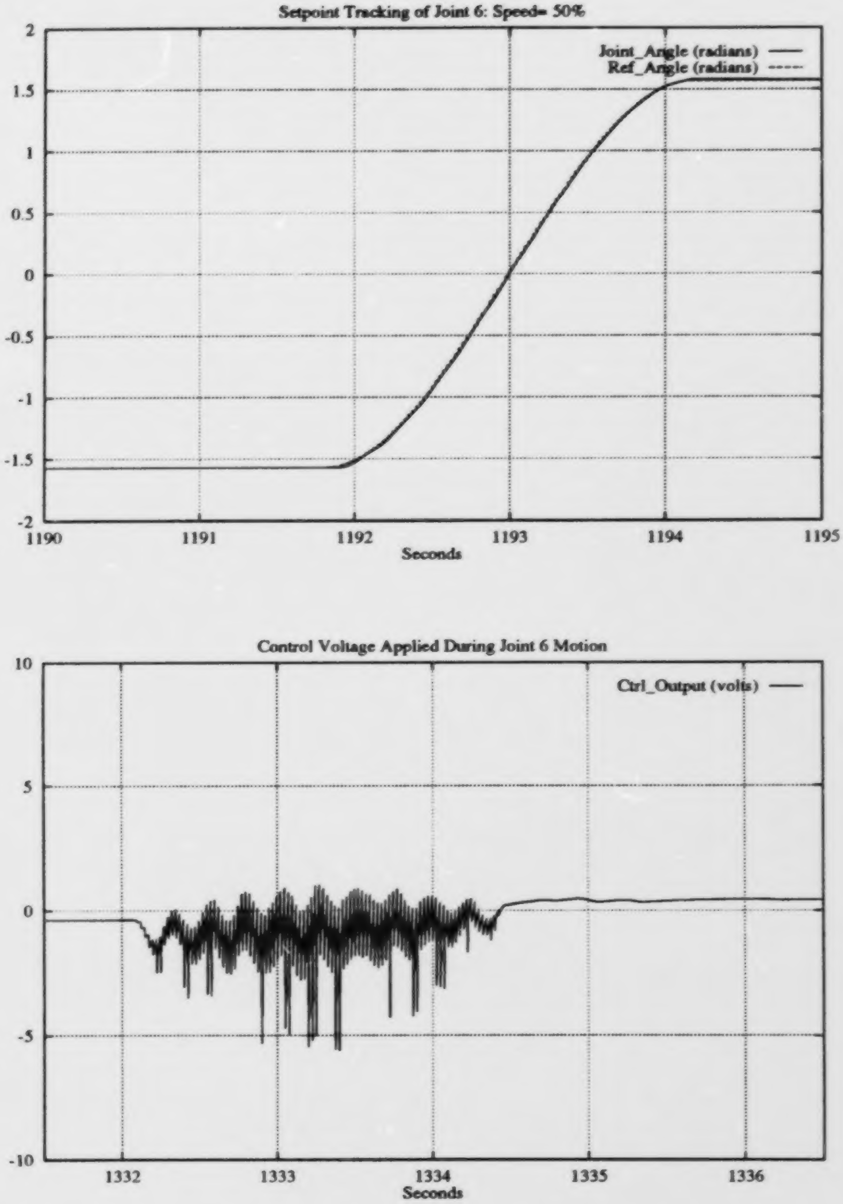

Figure 14: Joint 6 Motion and Control Signal at 50% speed

Chapter 7

Conclusions and Suggestions for Future Research

7.1 Features of the MRC

Kruszewski's single-CPU controller was successfully replaced with a homogeneous multiprocessor based controller (MRC) using coarse-grained task division to provide a reconfigurable robot controller research platform. The MRC is able to run more complex control algorithms at a higher rate of execution than the existing controller. Kruszewski's Controller ran only an integer PD controller for the first three joints of the PUMA, while the MRC runs a floating-point PID controller for all six manipulator joints. New controller algorithms are implemented as software modules using a well-defined format. These modules provide a more convenient path for integration of new controller algorithms, and more than one module may be linked at compile time to provide a choice of control algorithms at run time.

The features of the MRC are:

1. Multiple processors provide the computing power necessary for the implementation of sophisticated control algorithms.
2. A UNIX-like Real-Time Operating System is used to provide basic services such as real-time task management and interprocess and interprocessor communication.
3. The controller software consists of easily replaceable or reconfigurable modules, making modification of the controller convenient and minimizing the time spent recompiling the controller source code.
4. Multiple control algorithms may be linked at compile-time. One control algorithm is chosen at run-time, and the support software automatically configures itself according to the control algorithm's requirements.
5. The X Window System is used to provide a multi-windowed graphical user interface on a Sun 3/160 workstation for user interaction with the real-time system and graphical display of logged data.
6. Details of hardware are hidden behind object-oriented programming methods and standardized library function calls.

With the foundation of a research platform laid by this system, new work on more complex control algorithms or on improving the controller may proceed using this project as a stepping stone.

7.2 Suggestions for Future Research

The MRC possesses certain limitations that could be improved upon in future projects. Currently, the original LSI-11 computer in the Unimation controller chassis must be switched out manually when the controller is started. Ideally, the LSI-11 should be completely removed from the control loop, eliminating the need to disable it every time the robot is powered up. This would require extensive modification of the Unimation controller.

The older Unimation hardware is also starting to experience degradation of performance. The low-voltage power supply sometimes experiences difficult in supplying the demands of the Unimation hardware still in the system. The hardware is periodically shut down when low voltage detectors in the Unimation hardware detect a sagging supply voltage. It is strongly recommended that the Unimation computing and control hardware be removed entirely from the system, and the interface between the VMEbus controller and the Unimation joint amplifiers be simplified to reflect this change. These modifications should be undertaken before further research is attempted with this hardware.

The sensory capabilities of the system could be expanded with the addition of a force-feedback or vision system. Such feedback systems would allow research into such highly specialized forms of robot control as hybrid (force and position) controllers, or visual servoing techniques. Research in telecontrol could be supported with the addition of remote operation devices such as a 6 degree-of-freedom joystick, or even a dataglove.

The X Window System could be used more effectively with the controller. Controller design software where the component modules are designed and configured graphically by the user would eliminate a majority of the effort involved in setting up a controller experiment. Custom controller modules, along with the standard supporting modules, could be chosen from a library and interconnected graphically on a design screen using 'drag and drop' techniques. Actual code generation and compilation would occur 'behind the scenes' and the user would merely have to click the mouse on a button to build the controller, and again on another to start running it.

Elements of Chimera II have been designed to execute on either a real-time platform or the Sun host. A useful extension to the robot controller would be to utilize the Sun fileserver workstation (see Figure 7) as a simulations platform for control algorithms before they are implemented with the PUMA. The use of a computer model of the PUMA dynamics coupled with a reconciliation of the portions of Chimera II not available for non-real-time use would allow simulation of control algorithms before implementation.

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Appendix A

System Configuration

This appendix details the hardware configuration of the controller. Memory maps for both the Sun 3/160 and the VMEbus cardcage are given, and board jumper configurations are also listed. Modifications to the VMEbus Encoder board are shown in Figures 15 and 16.

A.1 System Memory Maps

The system memory maps for both the Sun 3/160 host workstation and the Real-Time VMEbus cardcage are given in Table A.5 (A32 space), Table A.6 (A24 space), and Table A.7 (A16 space).

Address	Sun 3/160 Workstation	Real-Time VMEbus
`0x00000000` `0x000fffff`	DVMA Space	(Unused)
`0x00100000` `0x3fffffff`	Reserved by Sun	
Memory mapped from Real-Time VMEbus to Sun 3/160 by Bit3 Model 412 Remote RAM feature		
`0x40000000` `0x403fffff`	'master' RTPU's Dual Port RAM	
`0x40400000` `0x407fffff`	(Unused)	
`0x40800000` `0x40bfffff`	'servo' RTPU's Dual Port RAM	
`0x40c00000` `0x5fffffff`	(Unused)	
`0x60000000` `0x6000ffff`	Dual-Port RAM (32KB) - Accessed by both systems (Bit3 Model 412 Daughter-Board on slave Bit3 card)	
`0x60010000` `0x7fffffff`	Reserved by Sun	(Unused)
`0x80000000` `0xfeffffff`	Reserved for OEM and user devices	
`0xff000000` `0xffffffff`	Sun A24 address space	

Table A.5: System Memory map for A32 address space.

A.2 Board Configurations

A.2.1 Bit-3 Model 412 VMEbus to VMEbus Adapter

The Bit3 card located in the host Sun 3/160 workstation (the master Bit3) has been installed in Slot 4 of the workstation's triple-height VMEbus. The IACK and Bus Grant jumpers for this slot have been removed.

The Bit3 VMEbus to VMEbus adapter is installed in Slot 1 of the VMEbus cardcage. Since this is the bus arbiter slot, there are no VMEbus jumpers to configure on the backplane.

The settings for both (master and slave) Bit3 boards can be found in Section 2.3.2.1 of the Chimera II Program Documentation [SSK91]. The settings for the address windows on the local equipment are summarized here for reference in Table A.8.

A.2.2 Ironics IV-3220 Single Board Computer

The first Ironics IV-3220 Single Board Computer (designated the 'master' RTPU) has been installed in Slot 3 of the Real-Time VMEbus cardcage. The second Ironics IV-3220 Single Board Computer (designated the 'servo' RTPU) has been installed in Slot 4 of the Real-Time VMEbus cardcage. Both these cards require that the IACK and Bus Grant jumpers for their respective slots be removed from the backplane.

The jumper settings for this card may be found in Section 2.3.1.3 of the Chimera II Program Documentation [SSK91]. The settings of the base addresses of the two cards are given in Table A.9.

Address	Sun 3/160 Workstation	Real-Time VMEbus
0x000000	CPU board DVMA Space	(Unused)
0x020000 0x02ffff		VMEbus Encoder Board
0x030000 0x03ffff		
0x040000 0x04ffff		DVME-601 A/D Converter
0x050000 0x0fffff		(Unused)
0x100000 0x1fffff	Reserved by Sun	
0x200000 0x2fffff	Reserved for small Sun devices	
0x300000 0x3fffff	Reserved for large Sun devices	
0x400000 0x7fffff	Reserved for huge Sun devices	
0x800000 0xbfffff	Reserved for huge OEM and user devices	
0xc00000 0xcfffff	Reserved for large OEM and user devices	
0xd00000 0xdfffff	Reserved for small OEM and user devices	
0xe00000 0xefffff	Multibus to VMEbus memory space	
0xf00000 0xfeffff	Reserved for future use	
0xff0000 0xffffff	Sun A16 address space	

Table A.6: System Memory map for A24 address space.

Address	Sun 3/160 Workstation	Real-Time VMEbus
`0x0000`	Reserved for OEM and user devices	(Unused)
`0x2000` `0x2fff`	Bit3 I/O Range (Not used by Chimera II)	Bit3 I/O Range (Not used by Chimera II)
`0x3000` `0x7fff`	Reserved for OEM and user devices	(Unused)
`0x8000`	Reserved for Sun devices	
`0x9000` `0x90ff`		DVME-628 D/A Converter
`0x9100` `0xffff`		(Unused)

Table A.7: System Memory map for A16 address space.

Address Window	Master Bit3 Setting	Slave Bit3 Setting
I/O Range LO (start)	`0x20`	`0x20`
I/O Range HI (end)	`0x30`	`0x30`
Remote RAM LO (start)	`0x4000`	Disabled
Remote RAM HI (end)	`0x6000`	(LO > HI)
Dual-Port RAM LO (start)	`0x6000`	`0x6000`
Dual-Port RAM HI (end)	`0x6001`	`0x6001`
Address Biasing	Disabled	Disabled

Table A.8: Local jumper settings for the Bit3 VMEbus to VMEbus Adapter

RTPU Name	Base Address	SW3 Setting
master	`0x40000000`	4
servo	`0x40100000`	5

Table A.9: Base Address Settings for the IV-3220 SBCs

Jumper	Setting
DVME-601 Base Address	`0x040000 (A24)`
Address Modifier Selection	Standard Non-Privileged Data Access (`0x39`) Standard Non-Privileged Prg. Access (`0x3a`) Standard Supervisory Data Access (`0x3d`) Standard Supervisory Prg. Access (`0x3e`)
VMEbus Interrupt Level	Level 6
Single-Ended or Differential Inputs	Single-Ended Inputs
A/D Input Range	-10V to +10V
A/D Output Coding	Two's Complement
RS-232 Port RTS Output	Programmed by I/O bit 1 as output
RS-232 Port Input source to I/O bit 0	Taken from DSR (J2 pin 6)
EPROM Memory (Chip Type)	64 KB (2 x 27C256)

Table A.10: Jumper settings for the DVME-601 A/D Converter

A.2.3 Datel DVME-601 Analog to Digital Converter

The Datel DVME-601 Analog to Digital Converter has been installed in Slot 9 of the Real-Time VMEbus cardcage. The DVME-601 requires the IACK jumper to be removed for the slot the board is installed in. The Bus Grant jumpers have also been removed.

The majority of the jumper settings were taken directly from [Kru90] and are presented here in Table A.10 for reference in setting up the Chimera configuration file. The A/D port assignments are also from [Kru90] and are presented here in Table A.11 as a reference for configuring the controller's virtual devices.

A/D Input Port Number	PUMA Signal
0	Joint 1 Potentiometer
1	Joint 2 Potentiometer
2	Joint 3 Potentiometer
3	Joint 4 Potentiometer
4	Joint 5 Potentiometer
5	Joint 6 Potentiometer
6	Joint 1 servo current
7	Joint 2 servo current
8	Joint 3 servo current
9	SSRON HI Signal
10	STOPL Signal
11	BRK RLS MES Signal
12	(Unused)
13	
14	
15	

Table A.11: Port Assignments for the DVME-601 A/D Inputs

Jumper	Setting
DVME-628 Base Address	`0x09000 (A16)`
Address Modifier Selection	Short Non-Privileged I/O Access (`0x29`) Short Supervisory I/O Access (`0x2d`)
DTACK Delay Setting	250 msec
DAC Output Range	-10V to +10V
DAC Input Coding	Bipolar, Two's Complement

Table A.12: Jumper settings for the DVME-628 D/A Converter

A.2.4 Datel DVME-628 Digital to Analog Converter

The Datel DVME-628 Digital to Analog Converter has been installed in Slot 10 of the Real-Time VMEbus Cardcage. The DVME-628 does not use the IACK or Bus Grant lines, and the jumpers for these lines have been removed for the slot in which the card is installed.

The only jumper setting changed from those presented in [Kru90] is the Base Address setting. These jumper settings are presented here in Table A.12 as a reference for setting up the Chimera configuration file.

The D/A port assignments are also from [Kru90] and are presented here in Table A.13 as a reference for configuring the controller's virtual devices.

A.2.5 VMEbus Encoder Board

The VMEbus Encoder Board has been installed in Slot 15 of the Real-Time VMEbus cardcage. The VEB uses no interrupts and therefore no configuration of the VMEbus backplane jumpers is necessary.

The VEB required re-wiring to conform to standard modes of VMEbus access (Supervisory and Non-Privileged modes must be enabled at the same time). The updated jumper labels and schematics are found in Figures 15 and

D/A Output Port Number	Signal Application Point
0	Joint 1 Motor Amplifier Input
1	Joint 2 Motor Amplifier Input
2	Joint 3 Motor Amplifier Input
3	Joint 4 Motor Amplifier Input
4	Joint 5 Motor Amplifier Input
5	Joint 6 Motor Amplifier Input
6	Arm Power ON Enable
7	(Unused)

Table A.13: Port Assignments for the DVME-628 D/A Outputs

Jumper	Setting
VEB Base Address (Addsel)	`0x020000 (A24)`
DTACK Delay (DTSEL)	Position 1
Address Modifier Code (AMcode)	Standard Non-Privileged Data Access (`0x39`) Standard Supervisory Data Access (`0x3d`) (Jumper Position 1)

Table A.14: Jumper settings for the VMEbus Encoder Board

16 respectively.

The jumper settings for the VEB are presented in Table A.14 for reference.

A.3 CHIMERA II Configuration File

```
# CHIMERA II, Version 1.11 Configuration file for robo2
#
# Hardware Setup:
#       Sun3/160 Host
#       BIT3 Model 412 Adaptor, with 32K Bytes of Memory at A32 0x60000000
#       Ironics IV3220 RTPU at A32 0x40000000 with 4MBytes of memory
#       Ironics IV3220 RTPU at A32 0x40800000 with 4MBytes of memory
#       Datel DVME-601 A/D Converter at A24 0x040000 with 64KB Dual Port Ram
#       Datel DVME-628 D/A Converter at A16 0x9000 with 16Bytes of registers
#       VMEbus Encoder Board at A24 0x020000 with 20Bytes of registers

# o = options
o SUNTASFIX

# h = host workstation
#hb hostvme   hostname    hosttype   mboxtype  vec  adaptor
hb   Host      robo2        SUN3      VMEINTR   53  BIT3_412
#
#hh memspace  memaddr   memsize  ctrlspace ctrladdr ctrlsize
hh    A32    60000000    10000      A16      2000       20
#
#hr memspace  memaddr   memsize  trigspace trigaddr
hr    A32    60000000    10000   UNKNOWN     0
#
#hw device    vmespace  vmeaddr   vmesize
hw /dev/hxm0     A32    40000000 20010000
hw /dev/hxm2     A16        2000      4000

# r = RTPU
#r vmename  rtpuname   type    vmespace  vmeaddr vmesize trigspace trigaddr
r   Host     master   IV3220    A32    40000000 400000  AUNKNOWN    0
r   Host     servo    IV3220    A32    40800000 400000  AUNKNOWN    0

# d = device
#  Device Notes
#       dadc0 - administers the DVME-601 and reads the current sensor values
#       dadc1 - reads the joint pot values
#       ddac0 - writes control voltages to the PUMA joint amps
#       ddac1 - writes the power control signal to the PUMA
#       veb0  - administers initialization of VMEbus Encoder Board counters
#       veb1  - reads the VMEbus Encoder Board counter values
#
#   NOTE: because the remote devices do not work, dadc1 and veb0 MUST be
#       owned by the master RTPU, otherwise the data accesses to the devices
#       will NOT be correct.  NEVER read the VEB with veb0, since no mutual
#       exclusion on the counter latch will be in effect.
#
#d boardname  vme-name    space   vmeaddr    size  maj  min  vec  lev
d  master    /vme/sio0   LOCAL   FC460000    1     1    0    44    4
d  master    /vme/sio1   LOCAL   FC460000    1     1    1    44    4
d  servo     /vme/sio2   LOCAL   FC460000    1     1    0    44    4
d  servo     /vme/sio3   LOCAL   FC460000    1     1    1    44    4
d  servo     /vme/dadc0   A24      040000    1    12    0     0    0
d  master    /vme/dadc1   A24      040000    1    12    1     0    0
d  servo     /vme/ddac0   A16        9000    1    13    0     0    0
d  servo     /vme/ddac1   A16        9000    1    13    1     0    0
d  master    /vme/veb0    A24      020000    1    14    0     0    0
d  servo     /vme/veb1    A24      020000    1    14    1     0    0
```

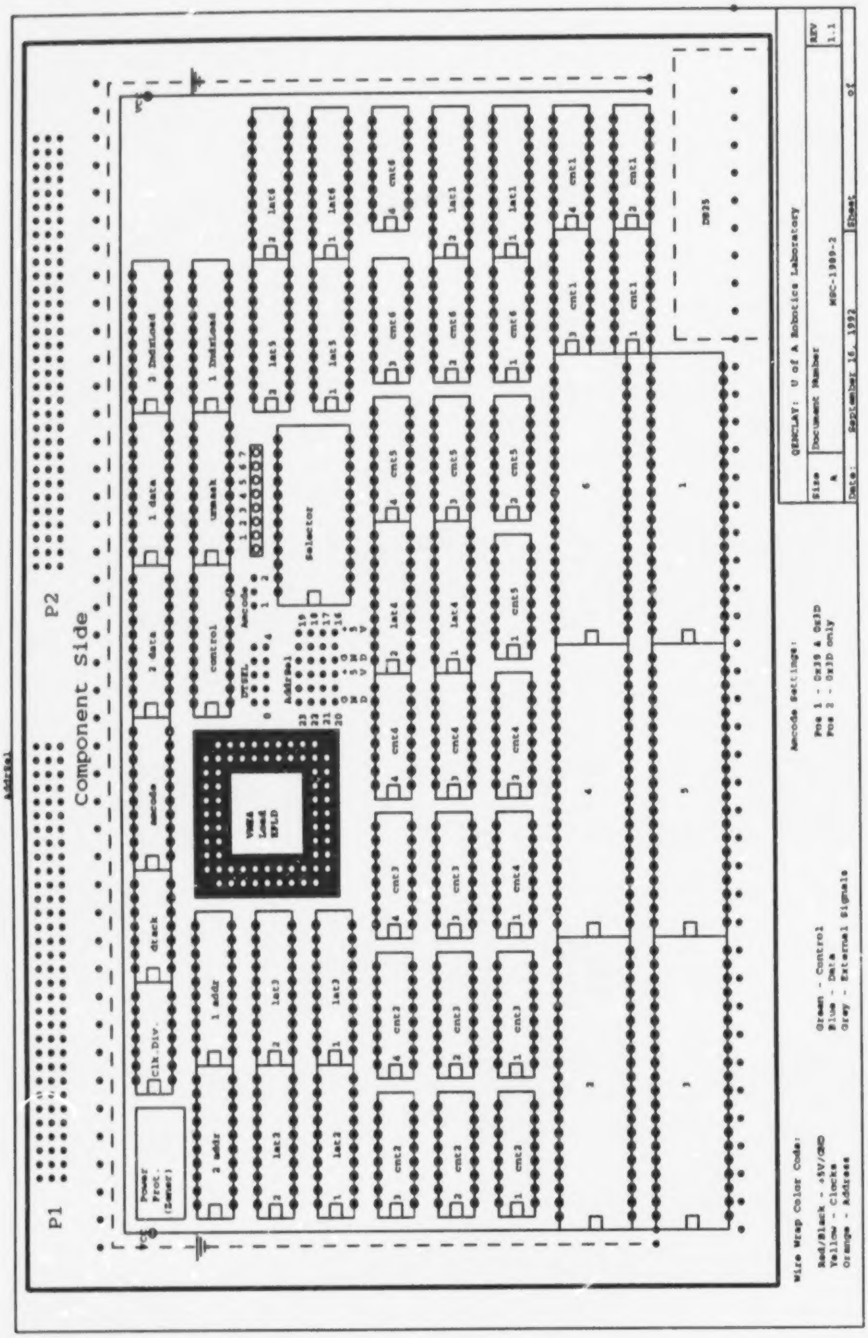
Component Side
P1
P2
Selector

Figure 15: Modified VMEbus Encoder Board jumper layout.

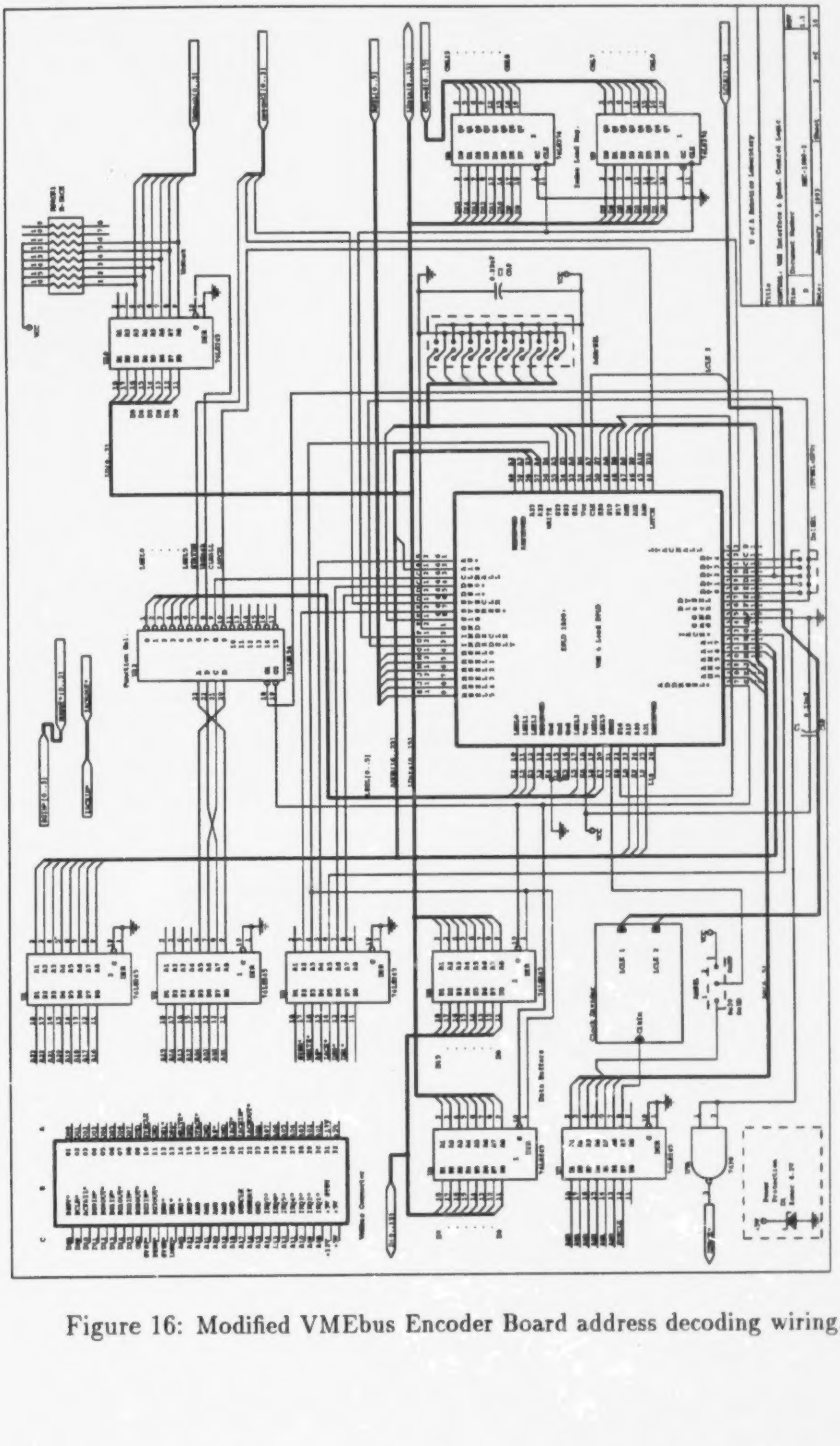

Figure 16: Modified VMEbus Encoder Board address decoding wiring.

Appendix B

PID Controller Module and Configuration Files

This appendix presents the PID control module linked to the controller for the results section of this project. The source code for the module itself is given, along with the State Variable Table Configuration file used to configure the state variable table for the PID controller. The Controller Configuration file, the DVME-601 Configuration file, and the Home Position file are included for reference.

B.1 Servo Server Module for PID Controller

B.1.1 Module Source

```
/************************************************************************/
/*                                                                      */
/*     pid_module.c                                                     */
/*                                                                      */
/*        This servo module implements a six-joint PID controller for  */
/*     a PUMA 560 robot arm.  The reference input is position, and      */
/*     the controller output is a voltage, fed to the joint amps.       */
/*                                                                      */
/*  SOURCE LOCATION                                                     */
/*                                                                      */
/*                                                                      */
/*  HISTORY                                                             */
/*                                                                      */
/*  24-Feb-92  Written by Darin Ingimarson at the Department of         */
/*             Electrical Engineering's Robotics Lab, University of     */
/*             Alberta, Edmonton, Canada.                               */
/*                                                                      */
/************************************************************************/

#include        <stdioCH.h>
#include        <svar.h>
#include        <servo.h>
#include        <cfig.h>
#include        <dvme601.h>
#include        <dvme628.h>
#include        <enc.h>
#include        "globalPUMA.h"


#define STRLEN  32      /* for name lengths */


/* Define the module's local structures */

typedef struct {        /* Variables global to the module */
    svarVar_t   *r_svar;        /* state variable for reference position */
    double      *c;             /* c(k) = controlled variable */
    double      *r;             /* r(k) = reference value (setpoint) */
    double      *u;             /* u(k) = applied control */
    double      *Kp;            /* Proportional gain */
    double      *Ki;            /* Integral Gain */
    double      *Kd;            /* Derivative gain */
    devInfo_t   *ad_ctrl;       /* info structure for A/D converter control */
    devInfo_t   *puma_pwr;      /* info structure for PUMA power control */
    devInfo_t   *ctrl_out;      /* info structure for control voltage device */
    devInfo_t   *encoder;       /* info structure for encoder counter device */

    /* These MUST be global so they can be initialized by pidOn() */
    double    period;           /* period of controller */
    double    e_km1[6];         /* error value to be saved for next cycle */
    double    delta_e_km1[6];   /* value of error signal delayed one cycle */
    double    u_km1[6];         /* old control value */
} pidLocal_t;
```

```
/* Define the module's constant, input, and output state variables */

char    *pidConst[]  = {NULL};
char    *pidInvar[]  = {"Ref_Angle","Kp","Ki","Kd",NULL};
char    *pidOutvar[] = {"Joint_Angle","Ctrl_Output",NULL};


/* Define the module's servoServer callable routines */

pidInit();
pidOn();
pidCycle();
pidOff();
pidFinish();


/* Define the servoFunc structure for this module */

servoFunc_t     pidFunc =   { pidInit, pidOn, pidCycle, pidOff,
                              pidFinish, NULL, NULL, NULL,
                              pidConst, pidInvar, pidOutvar };


/* Define the local setup routines */

static int     setup_svar_access();
static int     setup_hardware();
static int     read_cfig();


/***************************************************************************/
/*                                                                         */
/*      pidInit(argsize, argptr, svarptr, localptr)                        */
/*                                                                         */
/*         This routine initializes the state variables used by the        */
/*      control algorithm and the hardware I/O devices used to send        */
/*      control information to the PUMA and receive feedback from it.      */
/*                                                                         */
/*      Passed:  argsize  - size of DVME-601 config file name              */
/*               argptr   - ptr to filename of DVME-601 config file        */
/*               svarptr  - ptr to state variable table info               */
/*               localptr - pointer to 'local' data structure              */
/*                                                                         */
/*      Returns: SERVO_E_OK 'local' struct ptr in 'localptr' on success    */
/*               SERVO_E_BADSTR on no DVME-601 configuration filename      */
/*               SERVO_E_SVAR on state variable table init errors          */
/*               SERVO_E_ROBO|errno on hardware initialization errors      */
/*                 NULL is returned in 'localptr' for all errors           */
/*                                                                         */
/***************************************************************************/

int pidInit(argsize, argptr, svarptr, localptr)
    int             argsize;
    pointer         argptr;
    servoSvar_t     *svarptr;
    pidLocal_t      **localptr;

{
```

```
int                     rv;
register pidLocal_t     *local;


if ((local = (pidLocal_t *)malloc(sizeof(pidLocal_t))) == NULL) {
    *localptr = NULL;
    return(SERVO_E_ERRNO | errno);
}

local->ad_ctrl = NULL;
local->puma_pwr = NULL;
local->ctrl_out = NULL;
local->encoder = NULL;

printf("\n\n*** Initializing PID controller module ***\n\n");

/* Check for configuration filename */
if (argsize == 0 || argptr == NULL) {
    kprintf("Fatal Error: No configuration filename passed.\n");
    *localptr = NULL;
    return(SERVO_E_BADSTR);
}

if (svarptr == NULL) {      /* check for state variable table */
    kprintf("Fatal Error: State Variable Table pointer nonexistent.\n");
    *localptr = NULL;
    return(SERVO_E_SVAR);
}

/* Set up access to the state variables */
if ((rv = setup_svar_access(local, svarptr)) != I_OK) {
    *localptr = NULL;
    return(rv);
}

/* Set up the hardware */
if ((rv = setup_hardware(local, (char *)argptr)) != I_OK) {
    *localptr = NULL;
    return(rv);
}


/*
 * Enable the Arm Power On switch temporarily so that it is
 * possible to detect the PUMA_INITIALIZED state
 */

if ( ArmPower(local->puma_pwr, ARM_POWER_ENABLE) == I_ERROR ) {
    *localptr = NULL;
    return(SERVO_E_ERRNO | errno);
}

printf("*** Please power up and initialize the UNIMATION Controller ***\n");

/* DO NOT continue until the user has done what is asked */
while (PumaStatus(local->ad_ctrl) != PUMA_INITIALIZED)
    delay(0.1);

if ( ArmPower(local->puma_pwr, ARM_POWER_DISABLE) == I_ERROR ) {
    *localptr = NULL;
```

```
        return(SERVO_E_ERRNO | errno);
    }

    *localptr = local;

    printf("Thank you, the controller has been initialized.\n\n");

    printf("*** Please do not forget to toggle the RUN/HALT switch on ***\n");
    printf("*** the UNIMATION control computer from RUN to HALT and   ***\n");
    printf("*** back again.  Otherwise the UNIMATION CPU will shut    ***\n");
    printf("*** down the robot when you try to move it!               ***\n\n");

    printf("Controller TID = %i\n\n",gettid());

    return(SERVO_E_OK);

}



/************************************************************************/
/*                                                                      */
/*      pidOn(local, period)                                            */
/*                                                                      */
/*         This routine takes care of readying the PUMA equipment for   */
/*      the application of  power to the joint motors.                  */
/*                                                                      */
/*      Passed:  local  - ptr to local variable structure defined above */
/*               period - period of task (for information ONLY)         */
/*                                                                      */
/*      Returns: SERVO_E_OK on success                                  */
/*               SERVO_E_ERRNO on failure                               */
/*                                                                      */
/************************************************************************/

int pidOn(local, period)
    pidLocal_t  *local;
    double      period;

{
    int    i;


    if (ArmPower(local->puma_pwr, ARM_POWER_ENABLE) == I_ERROR) {
        kprintf("pidOn(): error enabling arm power\n");
        return(SERVO_E_ERRNO | errno);
    }

    /* Set the setpoint to the current position */
    if (encRead(local->encoder, local->r, RADIANS) == I_ERROR) {
        kprintf("Fatal Error: Controller unable to read joint positions.\n");
        return(SERVO_E_ERRNO | errno);
    }

    svarWrite(local->r_svar);   /* MUST write to global table too */

    /* Initialize the delayed variables to zero */
    for (i=0; i<6; i++) {
        local->u_km1[i] = 0.0;
        local->e_km1[i] = 0.0;
        local->delta_e_km1[i] = 0.0;
        local->u[i] = 0.0;
    }

    local->period = period;     /* initialize controller period */

    if (dacWrite(local->ctrl_out, local->u, VOLTAGE) == I_ERROR) {
        kprintf("Fatal Error: Controller unable to write control values.\n");
        return(SERVO_E_ERRNO | errno);
    }

    printf("*** Please turn on Puma arm power ***\n");


    /*
     * Until Arm Power On button is pressed,  servoStatus() should
     * indicate initialization is not complete
     */

    while(PumaStatus(local->ad_ctrl) != PUMA_ARM_POWER_ON)
        delay(0.1);

    printf("Thank you, the controller is now operational.\n\n");

    return(SERVO_E_OK);

}



/************************************************************************/
/*                                                                      */
/*      pidCycle(local)                                                 */
/*                                                                      */
/*         This is the heart of the controller module.  It executes a   */
/*      PID control algorithm once every sample period.  This routine    */
/*      must be as fast as possible.                                    */
/*         NOTE:  Due to the buffering hardware in the PIB, the         */
/*      control signal u[i] MUST be inverted!!!                         */
/*                                                                      */
/*      Passed:  local - ptr to local structure defined above          */
/*                                                                      */
/*      Returns: SERVO_E_OK on success                                  */
/*               SERVO_E_ERRNO | errno on fatal error, arm shut down    */
/*                                                                      */
/************************************************************************/

int pidCycle(local)
    pidLocal_t  *local;

{
    double          e[6], delta_e[6];
    register int    i;

    /* Read in current joint positions */
    if (encRead(local->encoder, local->c, RADIANS) == I_ERROR) {
        kprintf("Fatal Error: Controller unable to read joint positions.\n");
        return(SERVO_E_ERRNO | errno);
    }
    /* Do PID calculations for all 6 joints */
    for (i=0; i<6; i++) {
        e[i] = local->r[i] - local->c[i];
        delta_e[i] = e[i] - local->e_km1[i];

        /* check for joint excursion */
        if ((e[i] > PUMA_MAX_ERR) || (-e[i] > PUMA_MAX_ERR)) {
            kprintf("Error: Joint %i excursion from error envelope.\n",i);
            kprintf("e(t)= %f deg, max= %f deg\n",e[i]*180/pi(),
                e[i] > 0 ? PUMA_MAX_ERR*180/pi() : -PUMA_MAX_ERR*180/pi());
            return(SERVO_W_OFF);
        }

        /*
         * PID calculation.  Note the '-' needed to compensate for inverted
         * input to joint amps via the PIB.
         */

        local->u[i] = local->u_km1[i] - local->Kp[i]*delta_e[i]
            - local->Ki[i]*local->period*e[i]
            - local->Kd[i]/local->period*(delta_e[i] - local->delta_e_km1[i]);

        if (local->u[i] < DAC_MIN_VOLTAGE)
            local->u[i] = DAC_MIN_VOLTAGE;
        else if (local->u[i] > DAC_MAX_VOLTAGE)
            local->u[i] = DAC_MAX_VOLTAGE;

        local->u_km1[i] = local->u[i];
        local->e_km1[i] = e[i];
        local->delta_e_km1[i] = delta_e[i];


    }

    if (dacWrite(local->ctrl_out, local->u, VOLTAGE) == I_ERROR) {
        kprintf("Fatal Error: Controller unable to write control values.\n");
        return(SERVO_E_ERRNO | errno);
    }

    return(SERVO_E_OK);

}
```

```
/**************************************************************************/
/*                                                                        */
/*      pidOff(local)                                                     */
/*                                                                        */
/*         This routine will shut down power to the PUMA joint motors.   */
/*      However, it will NOT terminate the control task - the PUMA may   */
/*      still be re-started at some future point.                         */
/*                                                                        */
/*      Passed:  local - ptr to local structure defines above.            */
/*                                                                        */
/*      Returns: SERVO_E_OK on success                                    */
/*               SERVO_E_ERRNO | errno on error                           */
/*                                                                        */
/**************************************************************************/

int pidOff(local)
    pidLocal_t  *local;

{
    int    i;

    if ( ArmPower(local->puma_pwr, ARM_POWER_DISABLE) == I_ERROR )
        return(SERVO_E_ERRNO | errno);

    printf("Controller has been turned off.\n\n");

    return(SERVO_E_OK);

}


/**************************************************************************/
/*                                                                        */
/*      pidFinish(local)                                                  */
/*                                                                        */
/*         This routine performs the necessary termination tasks for     */
/*      the module.  It shuts down any devices used, and releases any    */
/*      memory that has been allocated.                                   */
/*                                                                        */
/*      Passed:  local - ptr to local structure defined above             */
/*                                                                        */
/*      Returns: SERVO_E_OK on success                                    */
/*               SERVO_E_ERRNO | errno on failure                         */
/*                                                                        */
/**************************************************************************/

int pidFinish(local)
    pidLocal_t  *local;

{

    /* Shut down all devices and free memory allocated in pidInit() */
    if (adcFinish(local->ad_ctrl) != I_OK)
        return(SERVO_E_ERRNO | errno);

    if (dacFinish(local->ctrl_out) != I_OK)
        return(SERVO_E_ERRNO | errno);

    if (dacFinish(local->puma_pwr) != I_OK)
```

```
        return(SERVO_E_ERRNO | errno);

    if (encFinish(local->encoder) != I_OK)
        return(SERVO_E_ERRNO | errno);

    free(local);

    printf("Controller module has terminated.\n\n");

    return(SERVO_E_OK);

}



/*
 *  Local setup and configuration routines
 */

/**********************************************************************/
/*                                                                    */
/*      setup_svar_access(local, svar_table_ptr)                      */
/*                                                                    */
/*         This routine sets up access to the state variable table    */
/*      through the pidLocal_t structure 'local'.  It was created to  */
/*      encapsulate the state variable table initialization.  If the  */
/*      elements of the state variable table change, this is the code */
/*      to modify the setup with.                                     */
/*                                                                    */
/*                                                                    */
/*      Passed:  local          - local structure declared in pidInit() */
/*               svar_table_ptr - ptr to state variable table         */
/*                                                                    */
/*      Returns: I_OK on success                                      */
/*               SERVO_E_SVAR (this can be passed back directly from  */
/*                  pidInit)                                          */
/*                                                                    */
/**********************************************************************/

static int    setup_svar_access(local, svar_table_ptr)
    pidLocal_t  *local;
    servoSvar_t *svar_table_ptr;

{
    register svarVar_t      *c_svar, *u_svar;
    register svarVar_t      *Kp_svar, *Ki_svar, *Kd_svar;

    /* get state variable pointers here */
    local->r_svar = svarTranslate(svar_table_ptr->vartable, "Ref_Angle");
    c_svar = svarTranslate(svar_table_ptr->vartable, "Joint_Angle");
    u_svar = svarTranslate(svar_table_ptr->vartable, "Ctrl_Output");
    Kp_svar = svarTranslate(svar_table_ptr->vartable, "Kp");
    Ki_svar = svarTranslate(svar_table_ptr->vartable, "Ki");
    Kd_svar = svarTranslate(svar_table_ptr->vartable, "Kd");

    /* Check state variable translations */
    if ( local->r_svar == NULL || c_svar == NULL || u_svar == NULL ||
        Kp_svar == NULL || Ki_svar == NULL || Kd_svar == NULL ) {
        kprintf("Fatal error translating State Variable Table elements\n");
        return(SERVO_E_SVAR);
```

```
   }

   /* Assign local svar pointers to ’local struct’ members for convenience */
   local->r = svarValue(local->r_svar, double);
   local->c = svarValue(c_svar, double);
   local->u = svarValue(u_svar, double);
   local->Kp = svarValue(Kp_svar, double);
   local->Ki = svarValue(Ki_svar, double);
   local->Kd = svarValue(Kd_svar, double);

   return(I_OK);

}


/*************************************************************************/
/*                                                                       */
/*      setup_hardware(local, adc_cfig_file)                             */
/*                                                                       */
/*         This routine performs all required hardware setup for PID     */
/*      control of the PUMA 560.  It was created to encapsulate the      */
/*      hardware setup.  If you want to modify the hardware setup,       */
/*      this is the routine to modify.  The hardware setup is:           */
/*                                                                       */
/*      DVME-601: administrative device only.  The filtering program     */
/*          is downloaded and started on the DVME-601                    */
/*      DVME-628: both default power and joint control port devices      */
/*          (/vme/ddac1 - power on/off,  /vme/ddac0 - control voltages)  */
/*      VMEbus Encoder Board: no administrative powers, joint position   */
/*          reading device only (/vme/veb1)                              */
/*                                                                       */
/*                                                                       */
/*      Passed:  local         - local structure declared in pidInit()   */
/*               adc_cfig_file - name of config filename for DVME-601    */
/*                                                                       */
/*      Returns: I_OK on success                                         */
/*               SERVO_E_ERRNO | errno on failure (this can be passed    */
/*                 back directly from pidInit)                           */
/*                                                                       */
/*************************************************************************/

static int      setup_hardware(local, adc_cfig_file)
   pidLocal_t   *local;
   char         *adc_cfig_file;

{
    adcConfig_t     *dvme601;
    pointer         ralloc[2];


    /*  Initialize controller hardware device drivers */

    if ((local->ad_ctrl = adcInit("/vme/dadc0", ADC_NOPORTS)) == NULL)
        return(SERVO_E_ERRNO | errno);

    if ((local->ctrl_out = dacInit("/vme/ddac0", DAC_DEF_PORTS)) == NULL)
        return(SERVO_E_ERRNO | errno);

    if ((local->puma_pwr = dacInit("/vme/ddac1", DAC_DEF_POWER)) == NULL)
    return(SERVO_E_ERRNO | errno);

if ((local->encoder = encInit("/vme/vebi", ENC_DEF_PORTS)) == NULL)
    return(SERVO_E_ERRNO | errno);


/* Disable the Arm Power On switch for safety */
if ( ArmPower(local->puma_pwr, ARM_POWER_DISABLE) == I_ERROR )
    return(SERVO_E_ERRNO | errno);


/*
 * Download and execute DVME-601 initialization/filtering programs:
 *    1) Download the filter program to the DVME-601
 *    2) Load the sample period for the filter
 *    3) Set EXEC ON - see DVME-601 manual for why this is done
 *    4) Download initialization AFB to DVME-601
 *    5) Execute it - this will set the sample period for the filter
 *    6) Download the AFB which calls the filter program
 *    7) Start the filter AFB
 * If any of these steps fail, abort task immediately!
 */

dvme601 = (adcConfig_t *) cfig(adc_cfig_file, read_cfig, ralloc);
if (dvme601 == NULL)
    return(SERVO_E_ERRNO | errno);


printf("Downloading DVME-601 programs.  Please Wait ... \n\n");

if (adcDownload(local->ad_ctrl, dvme601->filter) == I_ERROR) {
    cfigFree(ralloc);
    return(SERVO_E_ERRNO | errno);
}

if (adcSamplePeriod(local->ad_ctrl, dvme601->period) == I_ERROR) {
    cfigFree(ralloc);
    return(SERVO_E_ERRNO | errno);
}

if (adcExecute(local->ad_ctrl, EXEC_ON) == I_ERROR) {
    cfigFree(ralloc);
    return(SERVO_E_ERRNO | errno);
}

if (adcDownload(local->ad_ctrl, dvme601->init_afb) == I_ERROR) {
    cfigFree(ralloc);
    return(SERVO_E_ERRNO | errno);
}

if (adcExecute(local->ad_ctrl, AFB_FC) == I_ERROR) {
    cfigFree(ralloc);
    return(SERVO_E_ERRNO | errno);
}

if (adcDownload(local->ad_ctrl, dvme601->start_afb) == I_ERROR) {
    cfigFree(ralloc);
    return(SERVO_E_ERRNO | errno);
}
```

```
    if (adcExecute(local->ad_ctrl, AFB_FC) == I_ERROR) {
        cfigFree(ralloc);
        return(SERVO_E_ERRNO | errno);
    }


    printf("\nDownload of DVME-601 software is complete.\n\n");

    cfigFree(ralloc);

    return (I_OK);

}


/************************************************************************/
/*                                                                      */
/*      read_cfig(cinfo)                                                */
/*                                                                      */
/*         This routine is the formatter for the cfig() call in the     */
/*      setup_hardware() routine.  It reads in a configuration file     */
/*      file for the DVME-601 of the following form:                    */
/*                                                                      */
/*      FILTER         <filename for DVME-601 pre-filter program>       */
/*      INIT AFB       <filename for initialization AFB>                */
/*      START AFB      <filename for AFB to start the filter program>   */
/*      SAMPLE PERIOD   <sample period in seconds for the filter>       */
/*                                                                      */
/*                                                                      */
/*      Passed:  cinfo - info structure passed from cfig() call         */
/*                                                                      */
/*      Returns: filled form of type adcConfig_t (see dvme601.h)        */
/*                                                                      */
/************************************************************************/

static int    read_cfig(cinfo)
    cfigInfo_t  *cinfo;

{
    adcConfig_t     *dvme601;

    dvme601 = (adcConfig_t *) cfigAlloc(cinfo, sizeof(adcConfig_t));

    cfigCompulsory(cinfo, "FILTER", dvme601->filter, CFIG_STRING, STRLEN);
    cfigCompulsory(cinfo, "INIT AFB", dvme601->init_afb, CFIG_STRING, STRLEN);
    cfigCompulsory(cinfo, "START AFB", dvme601->start_afb, CFIG_STRING, STRLEN);
    cfigCompulsory(cinfo,"SAMPLE PERIOD", &dvme601->period, CFIG_DOUBLE, 1);

    return((int) dvme601);

}
```

B.2 Configuration files for Robot Controller

B.2.1 Controller Configuration File

```
#  controller.cfig
#
#   This configuration file is read by the Real-Time System upon startup.
#  It defines the names of the controller modules that have been linked
#  into the 'controller' executable.  This file must be modified by the user
#  when the controller executable is modified.
#
#  Fields:
#       MODULE NAME=    linked controller module name
#       MOTION GEN=     controller's motion generator module name
#       SVAR TABLE=     controller's State Variable Table configuration file
#       DVME601 CONFIG= configuration file for A/D converter
#       HOME=           file containing robot position initialization info
#       SAMPLE PERIOD=  default sample period for the controller
#       UPDATE PERIOD=  default setpoint update period
#       LOGGER PERIOD=  default data logging period

MODULE NAME=    pid
MOTION GEN=     motion
SVAR TABLE=     pid.svar
DVME601 CONFIG= dvme601.cfig
HOME=           home.cfig
SAMPLE PERIOD=  0.00165
UPDATE PERIOD=  0.025
LOGGER PERIOD=  0.005

MODULE NAME=    pidv
MOTION GEN=     motion
SVAR TABLE=     pid.svar
DVME601 CONFIG= dvme601.cfig
HOME=           home.cfig
SAMPLE PERIOD=  0.00165
UPDATE PERIOD=  0.025
LOGGER PERIOD=  0.005

MODULE NAME=    pos
MOTION GEN=     motion
SVAR TABLE=     pos.svar
DVME601 CONFIG= dvme601.cfig
HOME=           home.cfig
SAMPLE PERIOD=  0.00165
UPDATE PERIOD=  0.025
LOGGER PERIOD=  0.005

MODULE NAME=    open
MOTION GEN=     motion
SVAR TABLE=     open.svar
DVME601 CONFIG= dvme601.cfig
HOME=           home.cfig
SAMPLE PERIOD=  0.00165
UPDATE PERIOD=  0.025
LOGGER PERIOD=  0.005

EOF
```

B.2.2 State Variable Table Configuration File for PID Controller

```
#
#  pid.svar
#
#    This file defines the state variables required for the PID controller
#  implemented in the pid_module file.
#
#    The state variables required for this implementation are:
#       Joint_Angle - output of 'plant' or 'Controlled Variable'
#       Ref_Angle   - reference angle (the setpoint)
#       Ctrl_Output - Output voltage of the controller (for logging purposes)
#       Kp          - Position gain
#       Ki          - Integral gain
#       Kd          - Derivative gain
#

DEFINE  DOF     6
DEFINE  PI      3.141592653589793
DEFINE  TWOPI   6.283185307179586

NAME=   Ref_Angle
TYPE=   double
DESC=   Reference Variable
UNITS=  radians
NELEM=  DOF

NAME=   Joint_Angle
TYPE=   double
DESC=   Controlled Variable
UNITS=  radians
NELEM=  DOF

NAME=   Ctrl_Output
TYPE=   double
DESC=   Parameter
UNITS=  volts
NELEM=  DOF

NAME=   Kp
TYPE=   double
DESC=   Dynamic Gain
UNITS=  volts/radians
NELEM=  DOF
INIT=   130     135     75      110     50      70
MIN=    -1000   -1000   -1000   -1000   -1000   -1000
MAX=    10000   10000   10000   10000   10000   10000

NAME=   Ki
TYPE=   double
DESC=   Dynamic Gain
UNITS=  volts/radians
NELEM=  DOF
INIT=   25      175     140     200     90      100
MIN=    -1000   -1000   -1000   -1000   -1000   -1000
MAX=    10000   10000   10000   10000   10000   10000

NAME=   Kd
```

```
TYPE=   double
DESC=   Dynamic Gain
UNITS=  volts/radians
NELEM=  DOF
INIT=   0.4     .4      .35     0.1     0.11    0.1
MIN=    -1000   -1000   -1000   -1000   -1000   -1000
MAX=    10000   10000   10000   10000   10000   10000

EOF
```

B.2.3 DVME-601 Configuration File

```
#
# dvme601.cfig
#
#   This file contains configuration information for the DVME-601 A/D
# converter.  It is loaded by a controller servo module on initialization of
# robot control hardware.  Refer to the DVME-601 manual for an explanation
# of AFBs.
#
# Fields:
#       FILTER            Motorola S-Record file containing A/D prefiltering
#       INIT AFB          Application Function Block for initializing the board
#       START AFB         Application Function Block for starting A/D sampling
#       SAMPLING PERIOD   Default sampling period fro A/D conversion
#

FILTER          ../dvme601.chim/filter601.s2
INIT AFB        ../dvme601.chim/init.afb
START AFB       ../dvme601.chim/sample.afb
SAMPLE PERIOD   0.001

EOF
```

B.2.4 Home Position File

```
#
#       home.cfig
#
#          Generated using the makehome utility.  DO NOT EDIT.
#       Joint angles in degrees
#

JOINT ANGLES=   0.000000  -90.000000  90.000000  0.000000  0.000000  0.000000

POT VOLTAGES=   2.460334  2.470098  2.479861  2.479861  2.474979  2.592138

EOF
```

Table A-7. Continued (Hector overstorey 1967).

	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	2	0	0	0	2	0	1	0	0	1	1	1
AL SEED	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1
PC TRANS	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	1	4	0	2	2	0	2	3	6	0	1	0	1	0	1	2	0	0	1	0	1	0	1	0	1	2	1	1	2	4
AL TRANS	1	0	0	1	0	0	0	0	0	1	1	1	1	0	1	2	1	0	1	0	0	0	0	0	0	0	1	0	0	1
PC 1-3	4	3	2	6	2	2	4	3	3	3	2	0	4	3	1	1	3	3	1	1	0	0	0	0	1	3	1	1	1	2
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3	3	1	0	0	0	0	0	1
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 3-6	9	5	8	6	2	3	3	4	4	4	3	6	5	3	1	1	1	2	3	1	0	0	0	1	2	3	5	5	6	5
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	0	1	1	3	3	2	1	2	1	0	1	1	0	3	2	5	2	1	2	0	2	3	1	1	2	0	1	1	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	1	1	0	0	0	0	1	1	0	1	1	0	0

	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
PC SEED	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PG SEED	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	0	1	0	1	0
AL SEED	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	0	1	2	1	0	0	0	0	1	0	0	0	0	0	0	2	1	1	0	0	2	0	0	1	1	2	6	2	2	0
AL TRANS	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	3	0	2	0	1	0	1	0	0
PC 1-3	3	2	1	4	4	2	7	1	4	3	0	0	0	4	8	7	10	8	1	5	4	3	0	5	2	3	3	0	0	0
PG 1-3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	6	0	6	11	5	8	13	5	8	5	2	3	2	9	7	9	11	5	2	4	6	6	2	1	5	4	3	0	1	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	1	1	3	2	3	3	2	3	3	2	2	3	3	2	0	0	0	0	0	1	3	1	3	2	0	1	0	1	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	1	0	0	0	2	1	0	0	0	0	0	4	0	4	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0

	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
PC SEED	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0
PG SEED	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PC TRANS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0
PG TRANS	3	2	3	1	3	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
AL TRANS	2	1	0	0	0	0	0	1	1	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 1-3	0	0	2	0	2	1	1	0	4	0	3	3	0	12	4	5	2	0	1	2	0	0	1	0	5	3	7	12	8	7
PG 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	3	2	3	2	1	0	5	3	2	8	4	5	15	7	5	4	1	2	6	1	0	4	7	5	6	9	7	2
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	3	1	4	4	0	2	0	4	1	2	2	0	0	2	0	0	1	0	4	3	2	2	2	0	0	0	0	0	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	0	0	0	0	0	1	0	2	5	4	0	0	0	0	0	0	3	0	0	0	3	3	0	0	2	3

	391	392	393	394	395	396	397	398	399	400
PC SEED	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	1	0	0	1	1	0	0
AL SEED	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0
PG TRANS	0	0	0	1	0	2	1	1	0	2
AL TRANS	0	0	1	1	0	0	0	0	1	0
PC 1-3	2	5	0	2	0	0	1	2	1	0
PG 1-3	0	0	0	0	0	1	0	0	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0
PC 3-6	5	6	3	3	0	0	2	5	1	2
PG 3-6	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	1	3	1	1	4	2	5	0
PG 6-9	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0
DEAD	1	1	0	1	0	0	0	1	0	0

Table A-8. Density of overstorey species at Hector in 1989.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	1	0	0	3	6	4	0	1	2	3	0	1	2	4	2	1	2	1	0	0	0	0	4	1	1	1	0
AL SEED	4	9	1	2	0	1	4	1	3	1	0	0	0	2	0	2	0	2	0	0	0	0	1	0	0	0	1	1	1	1
PC TRANS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	0	0	0	11	10	21	9	10	5	10	8	7	13	4	0	3	4	6	3	3	4	2	3	3	6	4	6	6	5	5
AL TRANS	3	2	1	5	3	4	0	1	0	1	0	0	6	0	1	0	0	2	0	1	0	1	1	2	2	2	2	2	0	0
PC 1-3	0	0	1	0	0	0	1	0	0	0	1	2	2	2	0	0	0	0	1	1	0	0	1	1	2	0	4	0	0	0
PG 1-3	2	0	0	6	4	3	3	3	3	1	1	3	1	1	1	2	2	2	2	2	1	0	0	1	4	0	0	0	6	0
AL 1-3	10	7	3	4	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	1	0	0	2	1	1	0
PC 3-6	0	0	1	2	2	3	11	2	1	0	0	4	11	1	0	1	8	0	8	3	0	1	3	2	2	0	4	3	0	0
PG 3-6	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2	0	0	1	0	0	0	1	0	0	1	1	0
AL 3-6	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	0	0	2	0	4	0	2	4	1	3	2	2	3	3	2	4	3	1	0	1	1	3	2	3	2	1	3	2	1
PG 6-9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	1	0	0	1	0	0	0	0
PG 9-12	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	1	0	0	0	0	1	0	1	0	0	4	1	0	2	0	0	0	5	1	0	0	4	4	1	0	0	1	1

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
PC SEED	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	2	0	0	0	0	3	1	1	0	0	0	0	0
AL SEED	0	1	0	0	0	0	0	5	6	3	1	3	0	2	2	0	0	1	0	0	0	0	0	0	3	0	0	0	2	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PG TRANS	0	3	1	4	7	9	18	3	0	1	0	2	16	11	6	5	2	3	4	4	6	7	4	4	5	7	1	1	3	3
AL TRANS	1	2	0	4	2	3	2	6	0	15	8	5	3	0	2	1	1	1	4	0	0	2	0	0	0	0	0	0	0	0
PC 1-3	1	1	0	0	0	0	2	2	0	0	0	3	1	3	1	0	1	0	2	0	1	1	0	0	3	1	1	1	2	0
PG 1-3	3	1	1	2	6	1	2	3	0	0	0	0	2	8	6	3	2	5	0	4	3	3	1	2	2	0	0	3	1	6
AL 1-3	0	0	0	0	1	0	2	0	0	3	4	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
PC 3-6	4	2	2	4	2	0	3	3	0	0	0	3	6	1	4	3	1	2	4	3	1	1	1	6	3	6	7	5	4	1
PG 3-6	1	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
AL 3-6	0	0	0	0	0	0	1	0	1	2	3	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PC 6-9	1	1	3	5	2	0	3	2	0	0	1	1	1	1	0	2	4	1	1	0	4	0	3	5	2	3	2	1	2	1
PG 6-9	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	2	0	0	1	1	0	0	0	0	0	0	1	1
PG 9-12	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	3	1	0	0	0	1	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	3	2	2	2	0	0

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PG SEED	0	1	0	0	0	0	0	0	2	0	0	1	0	0	2	1	0	0	2	0	1	0	1	1	3	0	1	1	0	0
AL SEED	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	2	3	2	0	3	0	2	1	3	0	0	1	1	1	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PG TRANS	7	2	3	5	6	5	7	5	5	7	5	0	5	2	4	10	11	4	3	3	1	2	8	11	15	4	1	5	2	8
AL TRANS	0	0	1	1	0	1	0	0	0	1	1	1	1	1	3	2	3	1	0	2	2	3	4	6	8	6	0	2	0	1
PC 1-3	0	0	2	1	6	0	1	0	2	1	0	0	1	1	0	1	0	2	3	0	0	1	1	1	1	1	0	0	2	2
PG 1-3	8	3	0	0	3	3	1	2	1	6	3	0	1	2	2	4	6	1	3	5	5	6	1	4	1	2	0	1	3	0
AL 1-3	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	3	3	0	1	2	1	3	2	2	2	0	0	0	2
PC 3-6	2	1	8	5	8	5	2	2	3	0	1	3	1	3	4	2	4	5	3	5	5	4	7	4	4	2	6	4	5	6
PG 3-6	1	0	0	0	0	0	0	0	1	0	0	1	0	2	0	0	2	0	0	0	1	0	2	1	0	1	2	0	0	0
AL 3-6	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	4	4	3	3	1	3	1	4	3	5	1	2	2	3	1	1	2	1	0	1	3	2	3	3	1	3	4	2	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	0	0	4	0	0	1	0	0	0	0	1	0	0	0	1	3	0	0	1	0	3	2	0	1	0	1	4	2

	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	2	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0
AL SEED	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	3	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	0	7	3	7	7	10	0	5	3	1	5	7	3	4	4	6	6	6	1	3	2	3	2	4	5	12	7	2	3	2
AL TRANS	1	1	0	1	0	1	0	0	0	0	1	0	0	0	1	0	0	3	3	0	0	0	1	1	4	8	0	3	3	0
PC 1-3	1	3	0	1	3	2	2	2	0	1	2	5	2	2	1	1	2	5	1	0	0	1	1	0	1	2	0	0	0	3
PG 1-3	1	0	0	4	2	2	0	0	0	1	3	2	2	0	0	2	3	2	1	1	0	0	1	1	1	0	4	4	1	0
AL 1-3	1	0	0	0	0	1	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	7	0	0
PC 3-6	4	2	3	6	6	7	6	6	3	1	1	7	6	3	2	2	5	7	8	3	8	5	3	6	1	4	4	6	3	3
PG 3-6	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
PC 6-9	2	1	2	0	3	2	1	2	1	3	1	2	3	2	3	2	4	1	1	1	1	1	2	1	1	1	2	0	2	3
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	4	0	1	2	0	1	1	0	0	1	3	3	4	1	0	0	1	4	2	1	3	1	1	3	2	1	6	1	2	2

Table A-8. Continued (Hector overstorey 1989).

	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	0	0	0
AL SEED	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	1	2	3	5	12	8	7	3	2	3	1	7	5	2	2	3	8	7	2	1	0	2	4	2	3	0	2	1	0	4
AL TRANS	2	4	2	7	8	0	5	0	0	2	1	1	0	1	0	1	8	0	0	0	1	1	1	0	0	0	0	0	0	0
PC 1-3	0	0	1	0	1	1	1	1	0	1	2	3	2	0	1	1	2	3	1	6	3	2	3	2	0	0	1	3	3	0
PG 1-3	1	0	1	1	3	1	4	4	1	1	0	0	1	1	0	0	0	4	2	3	1	3	1	0	1	0	1	1	0	3
AL 1-3	0	2	9	2	2	1	0	1	3	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0
PC 3-6	2	3	2	1	1	1	2	1	1	2	11	8	6	5	5	5	3	5	7	7	6	7	2	3	0	3	2	0	4	2
PG 3-6	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	2	1	3	1	3	4	1	4	3	2	2	2	3	3	2	3	2	2	2	1	1	4	4	3	4	3	1	2	3	5
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	1	0	1	0	0	0	0	1	3	3	0	1	1	2	2	2	3	1	0	1	0	2	0	0	0	1	2	3

	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	1	0	0	0	2	0	0	0	0	0	1	0	0	0	0	1	0	2	0	2	0	1	1	0	0	0	0	0	0	1
AL SEED	1	0	0	0	2	1	1	2	0	1	1	1	2	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	4	3	2	4	7	6	6	6	7	3	4	2	4	7	4	7	3	1	5	11	4	0	0	0	2	0	2	2	10	0
AL TRANS	1	0	0	0	1	4	4	9	3	2	2	1	4	4	0	2	1	0	0	1	0	0	0	0	0	0	1	0	0	0
PC 1-3	1	1	0	0	1	0	1	3	0	1	0	2	1	0	1	0	0	1	0	0	0	0	0	1	1	0	2	0	3	5
PG 1-3	0	0	3	1	6	1	2	1	3	0	0	1	2	2	4	1	0	0	4	4	0	0	0	1	0	0	3	2	2	0
AL 1-3	0	1	1	0	0	0	0	0	0	2	2	2	2	1	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0
PC 3-6	2	3	3	1	1	1	2	4	5	1	2	2	0	2	2	5	0	1	1	1	2	2	7	3	2	2	1	4	6	1
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	3	2	2	0	4	1	3	0	0	2	4	1	2	2	2	4	2	1	2	3	2	2	5	0	3	6	2	3	3	1
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	1	0	1	0	0	0	0	0	2	0	1	0	0	0	2	0	0	0	1	0	0	0	0	0	1	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	2	1	0	0	0	0	0	0	0	1	0	0	0	2	0	2	0	0	0	3	0	1	0	0	3	0	0	1	1	2

	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	0	0	0	0	0	2	0	0
AL SEED	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
PC TRANS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
PG TRANS	2	5	3	2	5	1	0	2	4	3	2	2	7	1	7	3	8	3	7	3	1	2	3	1	0	3	2	4	6	2
AL TRANS	0	0	0	0	0	1	1	0	0	2	0	0	1	0	1	3	3	1	1	0	0	3	0	0	0	2	1	0	3	0
PC 1-3	0	0	1	0	0	2	2	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2	1	1	0	0	1	1	0
PG 1-3	0	2	0	2	0	0	0	2	3	1	0	5	0	2	0	0	3	1	2	1	0	0	0	0	3	1	2	1	2	4
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	2	0	1	2	0	0	3	1	1	1	1	0	0
PC 3-6	7	8	5	5	8	7	1	1	4	3	3	1	5	0	2	4	2	1	2	0	2	1	2	3	1	1	3	5	9	3
PG 3-6	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	3	0	2	3	6	3	3	3	2	2	2	1	2	2	3	2	2	2	2	2	1	2	1	6	2	3	2	2	0	1
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	1	0	1	0	1	3	1	5	3	0	1	0	0	1	2	0	0	0	0	0	0	1	1	0	1	1	5	5	0

	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
AL SEED	0	0	0	0	0	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	2	0	0	1	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	2	2	4	1	0	2	1	1	0	0	2	2	0	0	4	3	2	2	6	4	6	3	2	3	3	2	2	4	0	1
AL TRANS	0	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	0	4
PC 1-3	0	0	1	1	1	4	0	1	1	0	0	0	0	1	7	2	0	0	0	0	0	1	1	1	0	2	1	0	0	0
PG 1-3	1	0	2	0	0	0	4	1	0	0	1	0	0	0	0	1	1	2	0	0	0	0	1	0	0	5	2	1	0	1
AL 1-3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	1	0	0	1	1	0
PC 3-6	4	0	3	1	7	6	4	7	9	7	1	3	7	3	3	11	3	1	10	3	2	5	7	2	3	4	7	2	0	2
PG 3-6	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PC 6-9	2	0	3	1	4	2	1	2	2	4	6	3	5	2	1	0	3	1	3	3	2	3	4	1	5	0	2	1	2	1
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	0	0	0	1	2	7	0	0	2	2	1	2	3	1	2	1	0	4	5	3	1	2	3	0	1	0	0	2

Table A-8. Continued (Hector overstorey 1989).

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	0
AL SEED	0	0	0	0	0	2	2	0	0	2	0	0	2	1	1	0	1	1	0	0	0	1	0	0	0	0	2	0	1	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	3	2	2	3	6	2	1	2	3	2	1	0	0	3	0	0	6	1	2	0	3	2	4	3	3	2	3	2	0	1
AL TRANS	1	2	0	1	2	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PC 1-3	0	0	0	0	0	2	3	0	1	0	1	1	3	0	1	1	1	2	0	0	0	0	2	1	3	0	0	0	0	0
PG 1-3	0	0	1	5	3	3	1	0	0	0	2	1	0	1	1	0	0	1	0	1	0	3	1	0	0	0	2	2	0	1
AL 1-3	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	1	3	1	0	3	5	5	8	7	5	3	5	4	7	9	4	6	4	0	5	4	4	7	6	10	4	2	9	3	4
PG 3-6	0	0	1	1	1	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	2	3	1	3	3	2	3	2	3	4	2	3	3	2	1	5	4	1	3	2	1	1	3	4	3	2	2	1	1	2
PG 6-9	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	1	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	0	0	1	2	1	3	1	4	0	1	0	1	4	3	2	2	2	0	1	1	1	0	4	5	1	0	2	6	2

	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
PC SEED	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	3	0	0	1	0	1	2	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
AL SEED	0	0	0	1	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	2	2	0	1
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
PG TRANS	4	3	1	0	0	1	4	1	0	0	1	1	4	1	0	2	4	2	1	0	0	0	1	0	3	1	0	4	0	0
AL TRANS	0	0	0	0	0	1	2	0	1	0	0	1	0	1	0	2	0	0	1	0	0	0	1	0	0	0	1	0	1	0
PC 1-3	0	1	5	1	0	0	2	1	1	0	0	2	1	0	1	3	1	4	1	0	1	0	1	1	2	1	4	0	2	4
PG 1-3	0	1	0	0	0	1	0	1	1	1	0	2	1	0	0	3	1	0	0	0	1	0	0	1	2	0	0	1	0	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PC 3-6	4	7	8	2	1	1	4	3	2	1	3	2	4	2	4	1	2	10	9	0	1	5	4	2	3	9	4	11	6	10
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	1	3	5	2	3	2	3	5	1	3	1	2	3	6	3	3	0	0	1	1	3	3	5	1	0	2	0	1	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	2	2	1	3	0	1	0	0	0	0	0	0	2	0	1	2	0	2	3	3	4	0	2	1	0	3	8	2	1	1

	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
PC SEED	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
AL SEED	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	1	2	0	0	1	0	2	1	4	0	1	1	0	1	1	2	1	3	1	0	1	0	1	0	1	1	1	2	3	2
AL TRANS	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
PC 1-3	3	3	3	0	1	1	3	1	1	0	0	0	1	0	0	1	1	2	0	0	0	0	0	0	1	3	0	2	0	1
PG 1-3	0	0	0	1	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	1	3	0	0	1	0	1	0	1
AL 1-3	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1
PC 3-6	9	5	4	7	3	3	3	4	5	4	1	3	4	2	1	0	2	1	2	3	0	0	0	0	0	1	1	3	2	6
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	1
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 6-9	1	2	2	1	3	6	1	2	4	2	1	3	2	1	3	2	4	3	2	1	0	0	0	1	3	3	7	4	3	2
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	2	2	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	1	1	3	4	1	1	0	1	0	0	0	2	0	1	1	0	1	2	1	0	0	0	0	1	0	3	1	2	3	2

	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	1	1
AL SEED	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	2	1	2	0	0	0	0	0	1	0	0	0	0	0	0	2	1	1	0	0	1	0	0	2	0	2	1	3	2	1
AL TRANS	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	2	0	1	0	1	0	0
PC 1-3	1	3	1	3	1	2	3	0	3	1	0	0	2	2	4	6	2	6	1	2	2	2	0	2	0	0	1	0	0	0
PG 1-3	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	1	1	0
AL 1-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
PC 3-6	6	4	6	7	6	9	10	8	13	5	0	2	2	13	10	15	12	11	2	1	3	7	1	2	6	4	1	0	0	0
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	2	2	2	4	2	3	2	3	0	4	3	2	4	0	3	0	1	0	2	1	1	2	1	3	2	2	2	0	1	0
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	1	2	2	4	2	2	2	1	0	1	3	1	6	4	4	4	1	2	4	2	1	0	1	0	3	0	0	0

Table A-8. Continued (Hector overstorey 1989).

	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
PC SEED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
PG SEED	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0
AL SEED	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG TRANS	2	1	2	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
AL TRANS	1	0	0	0	0	0	0	1	1	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
PC 1-3	0	0	0	0	0	0	0	0	5	0	2	4	2	7	4	3	1	1	1	1	1	0	0	0	4	12	8	5	8	5
PG 1-3	0	1	2	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 1-3	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 3-6	0	0	3	1	3	2	0	0	4	3	3	8	4	6	9	7	3	3	0	2	6	1	1	4	10	9	7	7	12	3
PG 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 6-9	0	2	1	4	3	1	3	0	3	3	3	2	1	1	2	1	4	2	2	5	7	2	2	3	0	1	1	1	0	1
PG 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	0	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PG 9-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEAD	0	0	1	0	0	0	0	0	0	2	0	6	4	6	5	2	0	0	0	0	2	0	1	0	5	0	3	7	5	0

	391	392	393	394	395	396	397	398	399	400
PC SEED	0	0	0	0	0	0	0	0	0	0
PG SEED	0	0	0	0	0	0	1	0	0	1
AL SEED	0	0	0	0	1	0	0	0	0	0
PC TRANS	0	0	0	0	0	0	0	0	0	0
PG TRANS	0	0	0	1	0	0	3	0	0	3
AL TRANS	0	0	0	1	0	0	0	0	1	0
PC 1-3	3	2	0	1	0	0	2	2	2	0
PG 1-3	0	0	0	1	0	1	0	0	0	0
AL 1-3	0	0	1	0	0	0	0	0	0	0
PC 3-6	6	6	3	2	0	1	4	4	1	0
PG 3-6	0	0	0	0	0	1	0	0	0	0
AL 3-6	0	0	0	0	0	0	0	0	0	0
PC 6-9	3	0	1	4	1	2	2	1	4	2
PG 6-9	0	0	0	0	0	0	0	0	0	0
AL 6-9	0	0	0	0	0	0	0	0	0	0
PC 9-12	0	1	0	0	0	0	1	0	1	0
PG 9-12	0	0	0	0	0	0	0	0	0	0
DEAD	2	1	0	0	0	0	2	1	0	0

Table A-9. Bitterlich exposure estimates measured above all 441 quadrat corners in 1989. Values indicate percent exposure to sky.

Athabasca

48	30	48	43	26	33	26	32	20	33	57	57	45	34	32	45	40	49	46	54	43
44	41	43	30	47	28	33	32	47	36	36	43	56	46	38	55	44	33	68	59	51
41	46	41	41	40	26	34	36	36	25	28	58	92	51	38	30	32	48	97	52	86
85	51	55	57	64	51	36	34	30	35	35	43	47	42	46	60	80	80	97	94	81
64	25	57	52	69	50	28	32	34	31	28	35	28	35	38	53	72	18	83	58	56
21	38	57	33	46	50	67	52	51	24	36	39	26	29	23	42	82	51	91	70	58
65	90	52	52	47	28	59	44	35	52	23	27	33	31	40	57	44	44	24	90	67
55	43	30	31	34	55	42	76	63	18	39	30	41	42	29	86	47	82	85	85	90
61	66	72	43	35	39	51	35	71	32	38	46	35	52	34	34	69	56	44	26	73
56	69	64	30	31	38	53	39	49	28	19	34	42	42	32	35	35	41	43	77	31
60	71	66	40	53	40	40	51	48	52	43	23	22	39	34	20	53	38	76	73	58
90	21	77	45	51	47	52	61	53	47	51	36	29	54	48	48	41	33	29	75	53
35	76	57	67	50	59	54	13	58	53	38	65	54	52	63	60	36	43	43	71	46
53	44	38	83	43	86	53	42	34	63	60	19	52	51	28	44	29	33	44	48	42
52	45	55	42	45	61	74	47	46	54	85	76	54	51	56	48	38	49	49	44	39
38	38	57	53	57	41	51	86	91	31	81	24	90	36	48	59	56	31	50	60	34
28	76	78	22	57	51	79	83	47	75	40	39	33	44	89	81	56	35	54	45	41
33	43	81	47	48	43	56	68	54	47	54	61	33	33	61	74	78	29	46	50	34
23	29	32	54	36	39	49	35	45	42	73	35	71	46	40	42	42	51	51	57	75
9	18	38	47	54	39	53	60	43	51	61	70	86	65	45	48	38	56	43	57	34
22	9	33	18	60	33	26	39	40	32	60	47	67	82	28	25	21	38	35	55	61

Sunwapta

44	47	40	50	47	27	25	46	47	31	36	23	21	38	26	47	18	38	52	46	45
48	50	38	71	72	43	30	40	60	64	54	63	34	40	63	48	28	22	20	30	19
25	46	57	66	66	39	32	41	61	47	46	33	26	23	46	49	27	16	19	18	15
41	45	27	57	55	35	33	35	38	28	39	44	59	47	59	21	38	30	26	24	34
32	40	49	38	26	47	50	36	48	40	29	44	68	78	34	39	30	28	27	34	38
24	20	40	38	23	36	43	51	52	34	51	68	73	49	59	22	47	20	11	23	14
42	27	32	33	28	27	26	29	53	35	35	61	42	26	28	47	42	30	35	21	18
71	42	27	25	27	26	26	21	60	50	40	52	45	43	30	39	44	32	29	23	22
58	56	46	23	31	39	41	58	73	52	41	31	63	51	39	42	34	19	28	23	28
55	30	46	25	38	39	46	43	74	63	24	47	47	49	40	31	39	27	17	31	33
67	32	39	29	51	64	46	10	63	69	46	15	33	36	45	29	52	36	47	45	45
53	42	34	38	51	25	13	29	44	33	23	27	25	35	24	28	51	53	45	57	57
41	34	43	44	33	22	36	41	33	24	34	27	42	50	45	43	46	44	32	30	58
41	40	26	32	43	29	18	23	23	30	30	36	31	9	44	35	60	57	48	7	53
48	26	41	34	30	56	27	29	28	26	35	26	33	35	43	44	35	49	47	17	46
20	41	33	23	40	52	34	29	38	41	34	29	23	9	29	53	41	38	39	24	54
52	54	38	63	69	42	29	39	54	46	41	22	31	29	50	29	14	28	39	24	45
32	38	49	54	60	57	27	54	58	63	50	39	40	52	42	8	31	34	25	21	48
29	47	40	25	46	53	50	23	43	18	27	29	44	34	43	33	31	27	29	50	46
47	50	57	47	47	66	45	54	66	32	57	35	29	30	40	50	40	46	31	53	42
48	46	41	59	52	50	45	48	39	46	44	46	29	8	28	28	18	19	28	44	33

Table A-9. Continued.

Whirlpool

28	20	25	21	25	25	30	34	19	33	11	25	33	30	26	23	33	16	23	35	17
43	20	31	35	33	35	31	33	36	38	41	46	40	44	42	29	26	30	34	28	33
5	29	23	30	30	19	26	34	27	24	35	28	24	34	38	27	31	30	7	15	31
30	27	38	48	27	27	38	40	30	31	28	31	44	38	40	46	41	32	44	40	34
20	9	33	31	30	32	36	26	31	27	32	28	25	20	18	24	34	50	43	32	34
38	7	32	48	30	32	30	6	35	30	29	44	23	31	34	39	43	48	34	42	13
34	24	19	27	15	31	40	32	36	35	24	19	31	21	19	30	29	32	5	34	35
30	18	28	27	14	5	29	28	9	32	29	7	29	27	28	39	30	30	33	28	20
23	25	24	16	28	26	33	25	9	23	23	26	29	28	23	25	24	23	33	45	41
24	23	26	19	13	33	34	7	21	39	26	17	24	24	28	22	25	23	30	29	41
29	24	16	27	38	8	35	8	34	39	43	29	20	14	33	7	36	21	33	26	28
25	30	28	29	28	35	27	31	39	44	25	28	33	18	28	33	31	24	30	29	31
34	22	23	23	20	29	29	14	21	32	15	19	29	30	27	30	40	34	32	35	24
30	26	24	27	36	28	25	22	28	45	39	44	11	26	35	42	49	24	28	25	34
6	29	24	33	22	25	30	21	29	38	42	28	34	22	19	38	41	43	35	21	36
19	23	25	34	25	31	18	23	28	43	34	44	42	29	26	32	50	34	38	39	35
15	21	26	27	11	24	26	28	6	38	23	34	30	32	45	39	30	36	34	32	27
43	29	34	32	24	19	34	48	39	30	27	27	36	44	44	38	30	48	38	35	35
28	19	24	20	28	18	14	15	36	36	6	33	41	27	29	52	36	34	34	27	36
33	30	21	24	26	36	27	20	30	28	35	38	41	27	34	44	51	47	31	27	32
24	23	38	31	16	30	32	23	42	38	35	47	51	49	45	54	29	39	31	33	33

Hector

24	10	5	35	24	10	33	19	28	31	23	28	21	22	22	20	14	14	24	21	38
26	19	41	20	14	48	28	38	20	27	30	53	20	32	31	40	33	22	44	28	40
14	30	31	15	11	18	51	20	22	15	28	30	39	29	24	23	20	28	33	29	23
42	6	30	16	39	25	25	10	33	34	23	22	18	36	11	32	32	19	25	30	36
30	5	7	15	23	9	22	22	19	29	18	7	27	19	25	8	27	25	24	24	40
48	33	20	29	24	21	26	32	32	31	28	34	24	34	25	25	21	21	23	30	27
40	41	29	28	21	19	17	30	27	28	21	18	25	23	27	23	27	36	25	21	24
44	11	39	29	22	10	29	40	40	24	28	25	24	34	29	29	23	25	22	28	24
39	14	27	36	26	25	23	19	25	27	17	38	28	34	34	25	27	14	19	23	23
34	42	23	38	24	18	27	24	32	29	26	22	25	27	18	18	25	21	21	18	21
32	34	33	29	26	26	17	35	17	35	21	25	29	35	32	29	19	20	18	17	34
10	13	18	33	22	13	20	19	13	20	10	22	29	20	25	28	29	27	31	23	20
33	25	34	23	30	26	20	32	27	22	32	32	29	28	27	27	23	22	27	24	32
45	40	39	34	25	13	22	17	21	28	23	30	28	21	25	27	17	18	24	23	23
21	28	16	29	30	19	21	27	27	34	18	40	24	27	24	32	27	29	22	30	25
34	26	33	28	31	30	27	15	24	28	41	27	21	36	25	19	28	21	32	19	23
30	33	34	30	38	22	25	31	26	23	28	28	30	25	23	25	18	24	22	26	29
26	36	44	6	29	25	40	31	26	28	34	20	35	19	29	29	20	19	17	29	23
34	19	32	28	33	33	48	38	34	17	29	23	35	28	23	30	35	30	32	44	34
10	31	31	40	18	36	32	33	24	24	31	34	31	26	30	26	32	36	60	19	28
51	58	33	25	20	17	26	27	26	25	30	33	42	31	30	31	30	36	44	27	19

APPENDIX B

Note that the 1967 understorey estimates are in modified Braun-Blanquet cover classes (see Chapter 3) whereas the 1989 estimates are in percentage units.

Table B-1. Understorey species cover estimates for Athabasca 1967. Four letter abbreviations for species names are the same as used in Chapter 3.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SHCA	1	1	1	1	0	1	+	+	r	+	0	0	0	1	1	+	0	1	1	0	r	1	+	+	0	0	+	r	1	+
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	+	0	0	0	0	0	0	0	0
ROAC	+	+	r	0	0	0	0	r	r	0	r	0	r	r	0	0	0	r	0	r	r	0	r	r	0	0	0	0	0	r
SALIX	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	2	2	1	1	1	+	1	1	1	1	2	2	2	1	1	3	3	1	2	+	2	4	5	4	4	4	2	1	2	2
LIBO	+	+	+	+	1	r	0	0	r	+	1	0	+	1	0	+	1	1	+	+	r	1	+	r	r	0	1	0	0	r
FRVI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	+	+
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	r	0	+	+	0	0	0	0	r	+	r	0	0	0	0	0	0	0	r	r	r	0	0	0	0
PYCH	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r
ACMI	0	r	0	0	r	r	0	r	0	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r
ANHO	r	r	r	r	r	r	0	0	0	0	0	r	r	0	0	0	0	r	r	r	r	0	0	0	0	r	r	r	r	0
ANRO	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	r	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
SOSP	0	0	0	0	0	0	r	0	0	0	r	r	r	0	0	r	r	0	0	0	r	r	r	r	r	r	r	r	r	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	r	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
CARO	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	r	r	r	0	0	0	r	r	r	r	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
CABU	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0
ELIN	r	r	r	r	+	+	+	r	r	r	r	r	+	+	r	+	+	r	r	r	r	r	+	+	+	+	+	r	r	r
FESA	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0
CAREX	0	0	0	r	+	r	r	0	r	0	r	0	0	+	r	0	r	r	0	0	1	r	r	0	r	+	1	+	r	0
MOSS	1	+	2	3	3	4	3	4	5	2	1	1	1	3	4	+	1	3	3	4	2	1	1	+	r	+	2	2	2	2
LICHEN	1	1	2	2	2	1	1	3	2	1	1	1	1	1	1	1	1	1	1	2	2	1	+	1	+	1	1	1	1	1

Species	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
SHCA	r	1	1	1	r	r	1	1	+	+	0	0	+	1	r	1	1	1	+	1	+	r	0	1	+	1	1	0	r	r
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	1	0	+	0	r	0	0	r	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0
ROAC	r	0	0	0	0	r	+	+	+	+	+	+	r	r	r	0	0	0	0	r	+	r	r	0	0	0	r	r	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	1	1	1	1	+	+	1	2	1	1	2	2	1	3	+	1	1	1	+	+	1	1	1	+	2	3	4	4	3	3
LIBO	r	+	0	0	0	r	r	r	r	+	0	r	+	0	0	0	0	r	r	r	r	0	+	0	r	1	0	0	0	0
FRVI	r	+	+	r	r	r	r	r	r	0	r	r	r	+	r	r	0	r	r	r	r	r	r	+	r	r	r	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	r	0	0	r	r	r	0	0	0	0	0	0	0	0	r	+	r	r	0	0	0	0	r	+	+	r	0	0	r
PYCH	r	r	r	r	r	r	r	r	r	0	0	r	r	0	r	r	r	r	+	r	r	0	r	r	r	r	r	r	r	r
ACMI	0	r	0	r	0	r	r	0	r	0	r	r	r	r	r	r	r	0	0	r	0	r	r	r	0	r	r	r	r	r
ANHO	0	0	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	0	r	0	r	r	0	0	r	0	r	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	r	r	0	0	0	r	0	0	0	0	0	0	r	r	r	0	r	r	+	r	r
SOSP	0	0	r	r	0	0	0	0	r	0	0	r	r	r	r	0	r	r	0	0	r	r	r	r	r	r	r	r	r	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	r	0	0	0	0	0
GEAM	0	0	r	0	0	r	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
CABU	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	r	r	0	0	0	0
BRIN	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	r	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	r	r	0	r	r	r	r	0	r
ELIN	r	r	+	+	r	r	r	r	r	r	r	r	r	r	+	+	+	+	+	+	r	r	r	r	r	+	r	r	r	r
FESA	0	0	0	0	0	0	0	0	r	+	0	0	r	0	0	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0
CAREX	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	+	r	0	+	+	1	+	r	r	+	+	1
MOSS	3	3	4	4	5	5	2	1	2	1	1	2	1	2	3	4	3	3	4	4	3	1	2	3	1	+	r	1	1	1
LICHEN	1	2	2	1	1	2	2	1	1	1	1	1	1	1	2	2	1	2	1	2	2	2	1	2	1	+	r	r	1	1

Table B-1 continued (Athabasca understorey 1967)

Species	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
SHCA	+	r	+	+	1	2	1	+	r	+	1	r	+	r	+	+	r	0	1	0	+	0	0	+	0	r	1	0	+	+
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	r	0	r	0	+	0	0	0	0	r	0	r	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0
ROAC	r	r	r	r	0	0	r	r	+	+	r	r	r	0	r	r	r	+	+	r	r	+	+	r	r	r	0	r	0	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	2	2	2	3	1	3	r	1	1	r	+	+	2	+	2	1	2	1	2	r	2	1	1	2	+	3	3	2	3	1
LIBO	+	0	0	0	0	r	0	1	1	r	+	+	+	0	0	0	0	0	0	r	+	0	r	0	+	0	0	0	0	0
FRVI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	+	r	r	r	r	r	r	r	r	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	r	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	0	0	0	r	0	0	0	0	0	r	r	r	r	0	r
ACMI	r	r	r	r	r	r	0	1	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r
ANHO	0	r	r	0	r	0	0	0	0	r	0	0	r	r	0	r	r	r	r	r	r	0	r	r	0	r	0	r	0	0
ANRO	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	r	r	0	0	0	r	0	0	0	0	0	r	r	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	r	0	r	0	0	0	0	0	0	0	0	r	0	r	r	0	0	r	r	0	0	r	r	0	0	0	0	r
SOSP	r	r	r	r	r	r	r	0	r	0	r	r	0	r	r	r	r	r	r	r	0	r	r	r	r	r	0	r	r	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0	0	r	r	0	0	r	r	0	0	0	0
CARO	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GEAM	0	0	r	0	r	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	r	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0
ELIN	r	r	r	+	+	r	r	r	r	r	+	r	+	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+
FESA	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	r	r	0	r	r	r	r	r	0	0	0	0	0	0
CAREX	1	1	1	+	1	+	0	r	+	0	0	+	+	+	+	r	r	r	0	0	r	r	0	r	r	0	0	+	+	0
MOSS	+	+	1	+	1	1	3	1	3	4	3	3	1	+	1	1	1	1	1	3	+	1	1	1	1	1	r	+	+	3
LICHEN	1	+	1	+	+	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	+	r	1	1	1

Species	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SHCA	1	2	+	+	+	1	+	r	0	0	r	r	1	r	0	+	r	r	1	+	r	+	+	0	+	r	0	1	1	0
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	1	r	0	0	+	0	0	0	0	+	0	r	r	+	r	0	0	0	0	0	0	0	r	r	0	0	0	r	0	+
ROAC	+	+	+	r	0	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	0	0	r	r	r	r	+	+	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0
ARUV	r	+	+	1	2	2	3	3	3	2	4	2	1	1	3	4	+	+	r	1	2	2	3	2	1	1	2	1	1	1
LIBO	r	r	+	+	0	1	0	0	r	+	r	0	0	0	0	+	1	+	r	0	0	0	0	0	0	r	0	+	0	0
FRVI	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	+	r	r	r	r	r	+	r	r	r	r	r	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	+	+	0	0	0	0	0	0	0	0
PYCH	r	0	r	r	r	r	r	0	0	r	0	0	r	r	0	r	r	r	r	r	r	r	0	r	0	0	0	0	0	0
ACMI	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	r	r	r	r	r	r	r	r	r	r
ANHO	0	r	r	0	0	0	0	0	r	0	r	r	r	r	r	0	0	r	r	0	0	0	r	r	0	r	0	0	0	r
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	r	0	0	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	r	r	0	0	0	0	0	r	r	r	r	r	0	0	0	r	r	r	r	r	r	0	r	r
SOSP	r	0	r	0	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	r	r	0	r	r	r	r	r	r	r	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	r	0	0	r	0	0	r	0	r	r	r	r	0	0	0	r	r	0	r	r	0	r	r	r	r
CARO	0	0	0	0	r	r	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0	r	r	0	0	0	r	0	r
GEAM	r	0	0	0	0	0	r	0	0	0	r	r	r	r	r	0	0	0	r	r	0	r	r	0	0	0	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	+	0	0	0	0	0	0	0	0	0	0
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+
ELIN	+	r	r	r	+	+	r	r	+	r	+	r	r	r	r	r	r	r	r	r	+	+	r	r	r	r	r	r	r	r
FESA	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	r	r	r	r	r	0	r
CAREX	0	+	0	+	r	1	+	+	1	+	1	1	1	1	1	+	+	0	0	r	0	+	+	+	0	r	r	r	r	+
MOSS	1	2	2	1	1	r	+	r	+	1	r	r	+	1	1	+	1	3	4	3	2	1	1	1	1	1	+	1	r	r
LICHEN	1	1	2	1	1	1	1	r	+	1	r	r	+	1	1	r	1	1	1	2	2	1	1	1	1	1	1	1	r	r

Table B-1 continued (Athabasca understorey 1967)

Species	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
SHCA	r	r	0	r	r	r	r	r	1	1	+	1	1	1	1	0	1	1	0	0	0	+	0	+	+	+	+	+	+	+
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	+	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	r	0	r	r	r	0	0	0	r	0	0	0	0	0	0	0	r	0	+	r	r	0	0	0	0	+	0	r	0
ROAC	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0
SALIX	0	0	0	0	0	0	0	0	0	r	r	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0
ARUV	1	3	3	2	2	2	1	2	2	+	+	1	r	1	2	2	2	2	3	1	1	2	2	3	2	1	1	1	2	+
LIBO	0	0	0	0	+	0	0	+	0	0	0	r	+	1	0	0	0	+	0	0	r	+	+	r	r	+	2	+	+	r
FRVI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	r	0	r	+	+	+	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	+	r
PYCH	0	r	0	0	0	r	0	r	r	r	r	r	r	r	0	r	0	0	0	0	0	0	0	0	r	r	r	r	r	r
ACMI	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	0
ANHO	r	r	r	r	0	0	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	0	r	r	r	r	r	0	r
ANRO	0	0	0	0	r	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	r	r	0	0	r	r	0	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	r	r	r	0	0	0
SOSP	r	r	r	r	r	r	r	r	0	0	0	0	0	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	0	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	r	0	r	0	r	r	r	0	0	0	r	0	0	r	r	r	0	r	0	0	0	r	r	0	0	0	0	r	r
CARO	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	r	r	r	r	0	0	0	0
GEAM	r	0	0	0	0	0	0	r	r	0	0	0	0	0	r	r	0	r	r	r	r	r	0	0	0	r	0	0	r	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
CAPU	r	r	r	r	r	0	0	0	0	0	r	0	0	r	r	r	r	r	r	0	0	0	r	r	0	0	0	0	0	0
ELIN	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r	r	+	r	+	r	r	r	r	r	r	r	r	r
FESA	r	0	r	r	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	r	0	r	0
CAREX	r	0	0	r	0	0	r	r	r	r	0	+	r	r	1	1	1	+	1	1	1	1	1	1	1	1	0	0	+	+
MOSS	1	2	+	+	1	+	r	r	3	3	3	4	4	3	1	+	+	r	+	+	1	+	1	+	1	2	3	3	2	2
LICHEN	1	1	r	+	1	+	r	r	2	1	1	2	1	1	1	+	1	+	r	r	1	1	+	+	1	1	2	1	1	1

Species	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
SHCA	0	+	0	r	0	0	r	+	0	r	r	0	+	+	0	0	+	0	+	+	+	+	1	r	+	+	+	+	r	+
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	+	r	r	1	1	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	r
ROAC	0	r	r	1	r	r	r	0	r	+	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	+	0	0	0	0	0
ARUV	1	2	+	2	1	2	1	+	2	2	2	3	2	+	1	1	1	1	+	1	1	+	r	r	+	+	2	3	3	2
LIBO	0	+	r	0	0	0	0	0	0	0	0	0	1	1	0	1	0	r	+	r	+	+	r	r	r	1	1	+	+	0
FRVI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	r	r	r	r	r	0	r	0	0
PYCH	r	r	0	0	0	0	r	r	0	0	0	0	r	r	1	r	0	r	r	r	r	r	r	r	r	r	r	0	0	0
ACMI	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	0	0	0	r	0	r	r	r	r	r
ANHO	r	r	r	r	r	r	0	r	r	0	r	0	r	0	r	r	r	r	r	r	r	0	r	0	r	r	0	0	0	r
ANRO	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	r	r	r	r	r	0	r	r	r	r	0	r	r	0	0	r	r	0	r	0	0	0	0	r	0	0	0	r	r
SOSP	0	r	r	r	r	r	r	r	r	r	0	r	r	0	r	0	r	r	r	r	0	0	0	0	0	r	r	0	r	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	r	r	r	r	r	0	r	0	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	r	0	0	r
CARO	0	r	r	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r	r
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	+	0	0	0	0	0
ELIN	r	r	r	r	r	r	r	r	r	r	r	r	r	r	1	r	r	r	r	+	r	r	r	r	r	r	r	r	r	r
FESA	r	0	0	r	r	r	0	r	0	+	1	r	r	r	r	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r
CAREX	r	+	+	r	0	0	0	0	0	+	r	0	0	0	0	0	0	r	+	0	0	+	0	0	0	1	+	+	r	0
MOSS	1	1	1	+	1	1	1	2	1	1	1	+	1	1	1	1	1	1	1	1	2	2	4	4	5	3	2	1	+	1
LICHEN	2	1	r	+	r	1	1	+	1	+	+	+	+	1	1	1	+	r	1	1	1	2	2	1	1	1	1	+	+	1

Table B-1 continued (Athabasca understorey 1967)

Species	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
SHCA	0	r	1	1	+	+	+	1	+	r	r	r	r	+	+	0	0	r	r	0	0	r	r	+	r	r	0	r	r	r
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	0	r	0	0	0	0	r	0	r	0	0	0	0	r	0	0	r	+	r	r	+	0	1	0	0	0	r	0	0
ROAC	r	r	r	r	+	+	r	r	r	+	r	r	r	r	r	r	r	r	r	0	r	r	0	r	0	r	r	r	r	r
SALIX	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	2	3	3	2	+	+	r	1	1	2	1	2	1	1	1	2	1	1	3	1	+	+	1	1	2	1	1	1	1	2
LIBO	0	+	1	1	+	0	0	0	r	0	0	+	0	+	+	r	+	1	r	0	0	0	r	+	+	+	r	1	+	0
FRVI	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	r	r	r	r	r	r	0	r	r	r	0	0	0	r	r	r	r	0	0	0	0	r	r	r	0	0	r	r	r
ACMI	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r
ANHO	r	0	r	r	r	r	r	0	r	0	r	r	r	r	0	r	0	r	r	r	r	r	r	0	0	r	0	0	0	0
ANRO	0	0	0	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
SEST	r	r	r	0	r	r	0	0	0	0	0	r	0	r	0	0	0	r	r	r	r	r	r	r	0	0	r	0	r	0
SOSP	0	r	r	r	r	0	0	0	0	0	r	0	r	r	0	r	0	0	r	0	0	r	r	r	0	r	r	0	r	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0
VIAD	r	0	r	0	0	0	0	0	r	0	0	r	r	r	r	0	r	0	0	0	0	0	0	[illegible]	0	0	r	r	r	r
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	r	r	0	r	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	r	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	+	+	0	0	0	0	r	r	0	0	0	0	0	r	0	0	r	r	0	0	r	r	0	0	0	r
ELIN	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
FESA	0	0	0	0	0	+	r	0	r	0	0	r	r	r	r	0	r	r	+	+	+	+	r	r	r	r	0	0	r	0
CAREX	r	r	0	0	+	0	r	0	0	0	0	+	r	0	0	0	0	0	r	r	r	r	r	0	0	0	0	r	r	0
MOSS	r	r	1	1	2	3	4	2	3	2	1	+	1	1	+	+	1	1	1	1	1	2	1	1	1	+	r	1	1	+
LICH	1	r	1	1	1	1	1	1	1	1	1	+	1	1	1	1	1	+	+	+	r	r	1	1	1	1	+	1	+	1

Species	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SHCA		1	+	r	+	+	1	1	r	0	0	+	+	1	1	0	+	1	+	0	r	0	+	r	r	+	r	+	r	r
LODI		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
SPBE		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO		r	0	0	r	0	0	r	0	0	0	0	+	+	0	0	r	r	0	0	0	0	0	+	r	0	0	0	2	0
ROAC		r	r	r	+	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0
SALIX		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV		3	3	3	2	2	1	1	1	1	2	1	1	+	1	2	+	3	4	2	2	2	2	1	2	3	1	1	1	1
LIBO		0	0	0	0	r	+	+	1	r	0	0	+	+	0	0	0	1	r	0	r	+	1	1	1	0	0	0	+	0
FRVI		r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
GETR		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE		0	0	0	0	0	r	r	r	0	0	0	+	+	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0
PYCN		0	0	r	r	r	r	+	r	0	r	r	r	r	r	r	r	0	r	0	0	r	0	r	r	r	r	r	0	r
ACMI		r	r	r	r	r	r	0	r	r	+	r	0	0	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r
ANHO		r	r	r	r	r	r	r	0	r	r	r	r	r	+	r	r	r	r	r	r	r	r	r	0	r	r	0	0	r
ANRO		r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
ASCI		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST		0	r	0	r	0	r	0	0	r	0	r	0	0	r	r	0	0	r	r	r	0	0	r	r	0	r	r	r	r
SOSP		0	r	r	r	0	r	r	r	r	r	r	0	r	0	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r
STLO		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD		0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	r	r	r	r	r	r	0	0	0	0	0	0
CARO		0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0
GEAM		0	r	0	r	r	0	0	0	0	0	r	r	r	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0
VIAM		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
BRIN		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU		0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	r	0	0	r	r	0
ELIN		r	+	r	r	+	+	+	r	r	r	+	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
FESA		0	0	0	r	r	0	0	0	r	0	0	r	r	0	0	0	0	0	0	r	r	0	r	0	r	+	r	0	r
CAREX		0	r	r	r	r	0	1	+	+	r	+	r	r	0	+	+	r	+	0	0	+	+	0	0	r	r	0	0	r
MOSS		2	+	1	1	3	2	1	+	1	+	2	2	3	2	1	1	1	+	+	+	+	+	+	+	+	1	1	1	1
LICHEN		+	r	+	r	r	1	1	r	1	+	1	+	1	2	+	1	+	1	+	+	+	+	1	+	+	+	r	1	r

Table B-1 continued (Athabasca understorey 1967)

Species	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
SHCA	1	r	r	r	r	0	+	+	r	r	+	+	1	r	r	r	1	1	+	0	r	+	1	+	+	+	0	1	r	+
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	1	3	0	0	0	1	0	0	0	2	0	0	0	r	0	0	r	+	0	0	0	0	0	r	0	0	0	0	0	0
ROAC	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	+	r	r	r	r	+	r	r	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	1	2	2	3	2	3	3	2	1	2	1	2	1	1	1	2	1	+	2	2	1	2	2	2	2	2	2	2	2	2
LIBO	r	r	0	0	0	0	0	+	+	+	+	+	+	+	r	+	+	+	r	0	0	1	0	+	r	r	1	+	r	+
FRVI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	+	r	r	r	r	r	r	r	r	r	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	r	r	0	0	0	0	0
PYCH	0	0	0	0	0	0	r	r	0	0	r	r	r	0	r	r	r	r	r	r	r	r	0	r	r	r	r	0	0	0
ACMI	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r
ANHO	r	0	0	0	0	r	r	r	0	0	r	r	0	r	r	r	0	r	r	r	0	r	r	0	r	0	0	r	0	r
ANRO	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	r	r	r	0	0	0	r	r	0	r	r	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	r	r
SOSP	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	0	r	r	0	r	r	r	r	r	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	0	0	r	r	r	r	r	r	r	r	r	r	0	r	0	0	0	0	0	0	r	r	r	0	r	r	r	0	r
CARO	r	r	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	r	r	0	0	0	0	r	r	r	0	r	r	r	r	0	r	0	0	0	0	0	r	0	0	0	0	r	r	r	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	r	r	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r
ELIN	r	r	r	r	r	r	+	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
FESA	r	0	0	r	r	0	0	r	r	r	r	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	r	0	0
CAREX	0	0	0	0	1	+	+	r	r	r	0	0	r	r	1	1	0	0	r	0	r	0	0	0	+	r	r	0	r	r
MOSS	3	1	+	1	+	+	+	1	1	+	1	1	1	1	2	2	1	2	1	1	1	1	+	+	1	+	+	+	+	+
LICHEN	3	1	r	+	+	1	+	1	2	1	1	1	1	1	1	1	1	+	1	1	1	2	+	1	1	+	+	r	1	1

Species	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
SHCA	r	+	+	r	r	+	r	+	+	+	r	0	0	+	+	r	+	+	r	0	r	r	r	0	0	+	+	+	r	r
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	r	0	0	r	r	r	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	2	3	+	0	0	0	0	0	0	1	r	0	0	0	0	0	0	0	0	+	r	0	+	0	0	0	r	0	0	0
ROAC	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	+	+	+	+	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	2	2	1	1	1	1	1	2	+	1	1	2	2	3	1	1	1	2	2	2	1	1	2	2	1	1	1	1	2	2
LIBO	r	r	+	r	r	r	+	1	+	1	0	0	+	+	1	1	1	1	0	0	r	0	r	r	+	+	+	+	r	1
FRVI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0
PYCH	0	r	r	r	r	r	r	r	0	r	r	0	0	0	r	0	0	0	0	0	r	0	r	0	r	r	0	0	r	r
ACMI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0
ANHO	0	r	r	r	r	0	0	0	0	0	0	0	0	0	r	r	r	0	0	r	r	0	r	r	r	0	0	r	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	r	0	r	r	r	r	r	r	r	0	r	r	r	r	0	r	0	0	0	r	r	r	r	r	0	r	0	0	r
SOSP	r	r	0	r	r	r	r	0	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	r	r	r	r	r	r	r	0	0	r	r	0	r	r	r	r	0	r	r	0	0	r	0	0	r	r	0	r	0
CARO	0	0	0	0	0	0	0	r	0	r	0	r	0	0	0	0	0	0	0	0	r	0	r	0	r	r	0	0	r	0
GEAM	0	0	r	r	0	0	0	r	r	0	0	0	r	0	0	r	r	r	0	r	0	r	r	r	r	r	0	0	0	r
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	r	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	r	r	0	0	0	r	r	0	0	0	0
ELIN	r	+	r	r	r	r	r	+	+	r	+	r	r	+	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r
FESA	0	0	0	r	r	r	0	0	r	0	r	r	0	0	0	r	r	0	0	0	0	r	r	0	0	0	0	0	0	0
CAREX	r	0	+	1	1	1	r	0	0	0	r	0	0	0	r	r	r	+	1	+	r	r	+	r	+	r	0	0	r	0
MOSS	r	+	1	1	1	2	1	1	1	+	1	1	+	1	1	1	1	+	+	r	r	1	+	1	1	1	1	2	1	1
LICHEN	+	1	1	1	1	1	+	1	1	+	1	1	1	1	1	1	2	+	1	+	1	1	+	1	r	1	1	1	1	1

Table B-1 continued (Athabasca understorey 1967)

Species	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
SHCA	r	+	r	r	0	r	r	r	r	0	+	1	r	+	0	r	r	r	r	+	r	r	r	+	+	0	0	0	+	0
LODI	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	r	0	0	0	0	r	r	0	0	2	0	0	0	0	1	0	r	1	+	r	0	0	0	0	+	0	0	r	0
ROAC	r	+	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	2	1	r	2	2	1	2	+	1	2	1	1	1	1	1	2	1	r	1	3	1	+	2	3	2	2	3	3	2	3
LIBO	+	+	1	1	+	1	1	+	1	0	0	1	1	1	1	0	0	r	0	+	r	r	0	r	+	+	1	1	1	+
FRVI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	0
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
PYCH	0	r	0	r	r	0	0	r	0	0	0	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r	r
ACMI	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r
ANHO	r	r	r	r	r	r	r	r	r	r	0	r	r	0	0	0	0	r	r	0	0	r	r	0	0	0	0	0	r	r
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	r	0	0	0	r	0	0	r	r	0	0	0	r	r	0	r	r	0	0	r	r	0	r	r	r	r	r	r	r
SOSP	r	r	r	r	0	r	r	r	0	r	r	0	r	r	r	0	r	r	0	r	r	r	0	r	r	0	0	r	r	r
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	r	r	r	r	r	r	r	0	0	r	0	r	r	r	r	r	r	r	0	0	0	0	r	0	0	r	0	r	r
CARO	r	0	r	0	0	0	r	r	0	0	0	r	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	r	r	0	0	0	r	r	r	0	r	0	r	r	0	0	0	r	r	0	r	r	r	r	0	0	0	0	0	r	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	r	0	r	r	0	0	r	0	r	r	0	0	0	0	0	0	0	0	r	r	0	0	r	0	0	0
ELIN	r	r	r	r	r	r	r	r	r	r	+	r	+	r	r	r	r	r	r	r	+	r	r	r	r	r	r	r	+	+
FESA	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0
CAREX	r	0	0	0	r	+	r	r	0	+	0	1	1	+	+	+	0	0	r	r	r	r	r	0	+	r	+	r	+	+
MOSS	1	1	+	1	+	1	+	1	+	1	1	1	+	1	+	1	1	1	1	+	r	+	+	+	1	1	2	1	1	1
LICHEN	2	+	+	1	+	+	+	1	r	1	1	+	1	1	+	1	1	1	+	+	+	1	+	+	1	1	1	2	2	1

Species	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
SHCA	+	+	1	r	+	0	r	+	+	1	r	r	+	r	0	r	0	1	+	+	r	r	0	r	+	r	0	0	r	r
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	+	0	0	0	0	+	0	r	r	r	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	+
ROAC	+	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	3	1	3	1	2	3	1	2	1	1	2	2	1	1	2	1	2	4	3	1	1	1	+	+	2	2	+	+	r	+
LIBO	r	+	+	r	1	1	1	1	1	+	+	1	1	+	+	r	r	+	r	0	+	0	r	r	+	r	0	r	+	+
FRVI	+	+	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+
PYCH	r	r	r	0	0	0	0	0	0	r	r	r	r	r	r	r	r	0	r	r	r	0	r	r	r	0	0	0	r	r
ACMI	r	r	r	r	r	r	0	r	r	r	r	r	r	r	0	r	r	r	r	0	r	r	r	r	r	r	r	r	r	0
ANHO	r	0	0	r	r	0	r	0	r	r	0	0	0	0	r	+	r	r	r	r	r	r	r	r	r	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	r	0	r	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	r	r	r	0	0	r	r	r	r	0	0	r	r	r	r
SOSP	r	r	0	r	0	r	r	r	r	r	r	0	r	0	0	+	+	r	0	r	r	r	0	0	r	0	r	r	r	0
STLO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r	r	r	0	r	0	0	r	0	0	0
CARO	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
GEAM	0	0	0	r	r	0	r	0	r	r	r	r	r	r	r	r	r	0	0	0	r	0	0	0	0	0	0	0	r	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r	0	0	0	r	0	0	0	0	0	0	r	r
BRIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	r	0	0
ELIN	+	r	r	r	r	+	r	r	r	r	r	r	+	r	+	r	+	+	+	+	+	+	r	r	r	r	r	+	+	+
FESA	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	+	r	0	0	r	r	0	0
CAREX	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	r	+	r	0	0	r	r	r	0
MOSS	+	2	1	1	1	2	+	+	2	1	r	r	+	+	+	+	r	+	r	r	+	+	1	+	+	+	+	r	1	2
LICHEN	2	+	+	1	2	2	2	+	1	2	r	2	+	1	+	1	r	1	+	2	1	+	r	r	+	r	1	+	+	1

Table B-1 continued (Athabasca understorey 1967)

Species	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
SHCA				r	+	+	0	0	r	r	0	r	0	r	r	r	0	r	r	+	r	r	r	r	+	r	r	r	r	r
LODI				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO				0	+	r	0	0	0	r	0	0	0	0	r	r	0	0	0	+	r	0	0	r	0	0	0	0	1	0
ROAC				r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	+	+	r	0	0	r
SALIX				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV				2	1	2	2	1	2	3	3	4	4	2	1	2	3	2	2	1	4	2	2	+	3	1	2	2	2	2
LIBO				r	+	1	+	+	2	1	0	0	0	0	r	1	+	1	1	+	3	1	+	r	+	r	2	+	r	r
PRVI				r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	+	0	0	+	r	r	r	+
GETR				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POFR				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE				0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	r	0	0	0	r	0	0	0	0
PYCH				r	r	r	r	r	0	r	0	0	r	0	0	0	r	0	r	r	r	r	r	r	r	r	r	r	r	0
ACMI				r	0	0	0	0	r	r	r	r	r	r	r	r	r	0	+	r	r	r	r	r	r	r	r	r	r	r
ANHO				r	r	0	0	0	0	r	+	r	r	r	0	0	0	0	r	r	0	0	0	r	0	0	0	r	r	+
ANRO				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST				r	r	0	0	0	0	r	r	r	r	r	r	r	0	0	0	r	r	0	0	0	0	0	r	r	r	r
SOSP				r	0	0	r	r	0	r	r	r	r	r	r	r	r	0	r	r	r	0	0	r	r	r	r	r	r	r
STLO				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD				r	0	0	r	0	0	r	r	r	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	r	r	r
CARO				0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0
GEAM				0	0	0	0	0	0	r	0	0	0	r	r	0	r	r	r	0	r	r	r	0	r	r	0	r	r	r
VIAM				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU				0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
BRIN				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU				0	0	0	0	0	0	0	0	0	0	0	+	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0
ELIN				+	+	+	r	r	r	+	+	r	r	0	r	r	r	r	r	r	+	r	r	r	+	+	r	r	+	+
FESA				r	0	0	r	r	0	r	0	0	r	r	0	0	0	0	0	0	r	0	0	r	0	0	0	0	r	r
CAREX				r	0	r	0	0	0	0	r	r	0	r	r	0	0	r	0	0	r	r	0	r	0	0	0	+	r	r
MOSS				+	+	r	1	+	r	r	+	r	r	+	+	r	+	1	1	+	r	r	+	+	+	+	2	1	1	0
LICHEN				+	1	r	1	+	+	r	r	+	r	r	1	r	+	+	1	+	2	r	+	+	r	r	+	+	1	1

Species	391	392	393	394	395	396	397	398	399	400
SHCA	+	+	r	0	0	+	r	+	+	r
LODI	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	r	0	0	r	0	0	r	0
ROAC	r	+	r	r	r	r	r	0	0	0
SALIX	0	0	0	0	0	0	0	0	r	r
ARUV	1	4	2	4	4	1	1	2	+	r
LIBO	r	1	+	0	r	0	+	+	1	+
PRVI	+	r	r	r	r	r	+	r	r	r
GETR	0	0	0	0	0	0	0	0	0	0
POFR	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	r
PYCH	0	r	r	r	r	r	r	r	0	0
ACMI	r	+	r	r	r	r	r	r	r	0
ANHO	r	r	r	r	r	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	r	r
HICY	0	0	0	0	0	0	0	0	0	0
SEST	+	r	r	r	r	r	0	0	0	0
SOSP	r	r	r	r	r	r	r	r	0	0
STLO	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	r	0	0	r	r	0	0
CARO	0	0	0	0	0	0	0	0	0	0
GEAM	0	r	0	0	0	0	r	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0
CABU	0	0	r	0	0	0	0	0	0	r
BRIN	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0
ELIN	+	+	+	+	+	+	r	+	+	r
FESA	r	r	0	0	0	r	0	0	0	0
CAREX	0	0	0	0	0	r	r	+	r	r
MOSS	+	r	+	r	r	r	+	+	3	5
LICHEN	+	+	+	+	r	r	+	+	+	+

Table B-2. Understorey species cover estimates for Athabasca 1989

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SHCA	22	20	12	26	0	0	6	8	0	3	+	0	5	21	27	9	+	20	18	2	4	27	17	11	3	5	2	4	4	12
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	2	2	+	0	+	+	r	6	r	0	0	r	0	2	+	r	0	0	0	0	0	r	r	+	0
ROAC	9	4	+	0	0	0	0	2	2	+	r	0	+	0	0	0	r	+	0	2	+	0	+	+	+	0	0	+	0	2
SALIX	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	15	27	30	17	38	13	11	14	6	13	20	25	25	27	23	29	28	17	21	13	20	22	16	34	9	21	6	16	10	28
LIBO	23	28	25	8	5	7	5	0	3	1	8	0	1	2	3	3	3	3	3	0	0	0	0	+	3	4	6	0	0	2
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	+	3	+	2	3	3	4	2	+	0	2	3	2	2	r	+	+	2	+	+	+	+	+	+	2	3	2	+	2	+
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	+	0	0	+	0	0	+	r	+	r	0	0	0	0	r	0	r	0	0	0	0	0	0	0	r	r	0	0	0	r
ACMI	0	0	0	0	r	+	+	r	r	r	+	+	+	r	0	r	+	0	r	r	+	r	+	r	r	+	0	r	+	r
ANHO	+	+	0	0	0	r	0	r	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	r	+	r
ANRO	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
SEST	0	0	0	0	0	r	0	0	0	0	r	r	r	0	r	0	0	0	0	r	r	r	0	0	0	0	r	r	+	0
SOSP	0	r	0	+	0	0	+	0	0	r	r	+	+	0	0	r	r	0	r	r	r	0	r	r	r	r	+	+	+	r
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	+	0	r	0	0	0	0	0	0	r	0	0	r
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	r	0	r	0	0	0	0	0	0	0	0	r	0	0	r	r	r	0	0	0	0	0	r	r	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	+	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
ELIN	5	7	4	5	13	13	8	8	4	6	16	11	10	10	4	12	8	10	8	9	12	12	13	6	9	6	4	7	5	8
FESA	+	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	+	+	+	+	+	2	3	+	+	0	0	0	+	2	+	0	+	+	+	2	r	r	r	r	+	r	2	r	r	+
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	4	+	r	2
PLSC	+	+	2	19	9	5	8	28	40	18	0	4	3	8	7	6	4	4	5	7	+	15	r	+	5	5	12	+	r	+
POJU	r	r	r	r	r	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	+	0	0	+	0	0	0	+	0	+	+	r	0	0	0	0	0	0	0	+	0	0	0	0	0	r	+	0	+	0
CLADONIA	+	+	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
PELT.	8	2	3	2	3	2	5	2	3	3	4	2	3	+	+	+	+	2	5	6	+	0	+	0	+	2	4	+	12	4
STEREO.	4	+	+	0	0	0	0	+	r	2	2	4	0	0	+	0	0	0	0	+	r	0	+	r	0	r	0	2	6	2

Species	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
SHCA	2	17	24	+	4	5	12	6	12	+	r	+	19	21	+	26	7	22	15	12	6	+	9	18	21	26	5	r	9	3
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	r	5	14	5	+	+	0	0	+	0	r	r	r	r	r	5	r	r	r	r	r	r	r	r	0	r	r	r	0
ROAC	2	0	0	r	0	r	2	3	3	2	3	5	2	+	+	r	0	0	0	+	2	2	2	r	r	0	r	r	0	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	36	3	9	17	8	7	5	6	4	12	22	9	7	5	9	7	3	12	6	12	6	12	16	9	57	34	25	18	38	23
LIBO	2	3	0	0	3	4	3	5	7	+	0	8	11	0	0	0	0	5	7	+	5	+	13	0	6	0	r	0	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	+	+	+	2	2	2	+	+	+	r	0	+	+	+	+	+	+	0	+	+	2	+	2	+	+	+	+	+	+	+
ORSE	0	r	0	0	0	r	0	0	r	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	r	0	0	0
PYCH	0	r	r	r	r	r	0	r	0	r	0	0	r	0	0	r	r	r	r	r	r	0	r	r	r	r	0	0	0	0
ACMI	r	r	0	r	0	r	0	0	r	r	r	r	r	0	r	r	r	0	r	r	r	r	+	r	0	0	0	r	r	r
ANHO	0	0	0	0	0	r	0	r	+	+	+	r	0	r	r	0	0	0	r	0	0	r	+	0	0	0	r	r	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0
SEST	0	0	0	0	0	0	0	0	0	0	r	r	0	r	r	r	0	0	0	0	0	+	r	0	0	0	0	0	r	0
SOSP	0	0	r	r	0	0	0	0	r	r	0	0	r	r	r	r	r	0	0	0	r	r	r	r	r	r	+	+	+	+
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	r	r	r	0	r	r	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r
CARO	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0
CABU	0	0	r	0	0	r	r	r	r	0	0	0	0	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	4	5	6	5	3	4	6	4	3	4	6	7	9	8	5	13	10	3	4	9	3	3	2	8	11	8	12	12	7
FESA	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	+	r	+	+	3	2	+	+	+	r	+	+	+	0	+	+	2	2	2	+	+	+	+	+	+	0	0	0	0	0
DIUN	0	0	+	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	+	0	0	0	0	0	0
HYSP	3	2	0	+	2	4	6	0	+	0	0	0	2	3	0	3	0	6	0	+	5	0	0	0	2	r	r	0	0	0
PLSC	7	36	28	20	26	30	6	4	5	0	+	2	3	0	10	21	28	12	30	38	10	3	25	8	+	0	0	0	r	0
POJU	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
CLADINA	0	0	0	r	0	0	r	r	r	r	+	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0
CLADONIA	0	0	0	0	0	0	0	r	0	r	r	r	0	0	0	0	0	r	0	0	0	0	r	0	r	0	0	r	0	r
PELT.	9	6	2	2	3	5	2	4	5	0	6	2	3	0	2	2	3	5	3	6	7	7	23	20	+	2	+	0	2	11
STEREO.	0	0	0	r	0	0	0	r	r	r	+	r	0	r	0	0	0	r	0	0	r	+	r	r	0	r	r	r	r	r

Table B-2. continued (Athabasca understorey 1989)

Species	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
SHCA	7	2	+	13	8	23	10	17	2	9	34	8	8	11	15	3	3	5	22	+	+	0	2	+	r	7	22	2	7	21
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	+	+	2	+	5	r	0	r	r	0	r	2	r	r	3	r	+	0	0	r	r	r	0	+	r	0	2	r	3
ROAC	r	r	r	r	0	0	+	2	3	2	0	2	0	0	r	r	+	3	3	5	3	3	3	2	+	2	r	0	0	2
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	37	19	11	15	7	13	6	18	6	12	8	20	27	21	7	21	21	7	14	8	22	15	13	21	20	24	36	44	37	25
LIBO	0	0	0	0	2	+	+	2	5	6	8	+	6	0	3	0	0	11	0	10	+	4	6	4	5	11	0	0	2	+
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	+	+	+	+	r	+	r	+	+	2	2	+	+	r	5	+	+	+	2	2	+	+	+	+	+	2	2	3	3	2
ORSE	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	r	0	0	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ACMI	r	r	r	r	r	0	r	r	0	0	r	0	0	r	r	+	r	r	r	r	+	r	r	r	r	r	r	0	r	r
ANHO	0	r	r	r	r	0	0	0	0	0	0	0	0	r	0	0	r	0	0	r	0	0	+	r	0	0	r	+	r	0
ANRO	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r	0	0	0	0	0	r	r	0	0
SEST	r	r	0	r	0	0	0	0	r	0	0	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0
SOSP	+	+	+	+	+	r	0	0	0	r	0	r	r	0	+	r	+	r	0	0	r	r	r	r	r	r	r	r	r	r
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	r	0	r	0	0	r	r	0	r	r	0	r	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	r	r	0	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
ELIN	13	12	10	13	8	6	4	6	6	5	8	8	8	15	11	8	9	8	5	7	10	9	7	10	7	7	7	12	9	11
FESA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	0	r	r	0	+	+	+	+	+	r	r	r	r	r	0	r	r	+	r	r	0	r	+	r	r	0	0	+
DIUN	0	0	0	+	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
HYSP	2	r	0	0	3	4	0	0	+	7	3	0	0	r	2	0	r	0	r	+	3	2	+	r	0	+	+	0	2	3
PLSC	+	3	0	0	9	7	18	7	9	29	22	27	5	7	+	+	0	r	r	2	0	6	0	+	+	3	2	r	2	25
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	+	r	0	r	r	0	0
CLADINA	r	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	r	0	r
CLADONIA	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	0	0	r	0	0	0	0	0
PELT.	5	4	7	0	9	4	8	6	12	3	3	3	5	3	3	+	7	17	+	8	14	7	6	10	4	2	+	4	3	6
STEREO.	2	r	r	2	r	r	0	r	+	r	r	0	r	0	0	2	r	+	r	2	6	2	5	2	2	0	0	r	0	0

Species	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SHCA	27	25	18	18	21	15	22	8	r	+	3	3	16	7	2	10	2	9	12	6	5	5	5	6	5	2	3	5	6	+
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	12	r	0	r	8	0	3	0	0	7	0	r	8	11	2	r	r	r	r	2	r	r	3	r	r	0	r	4	3	4
ROAC	2	3	2	3	r	2	2	+	+	+	+	+	2	+	+	+	3	3	3	2	0	0	+	2	+	2	3	3	3	4
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0
ARUV	11	9	18	21	23	17	23	27	27	14	37	31	26	22	26	26	15	18	9	22	25	22	30	19	15	15	26	18	26	28
LIBO	+	16	11	10	r	4	5	0	0	10	0	0	5	+	0	+	27	22	8	+	7	9	0	+	+	9	0	11	0	0
JUHO	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	+	2	+	+	+	3	+	2	+	2	+	3	2	3	3	+	3	3	+	+	+	4	2	2	0	+	+	0	+	+
ORSE	0	0	0	r	r	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0
PYCH	r	r	0	r	0	r	0	0	0	0	0	0	r	0	0	0	0	0	r	r	r	0	r	0	0	0	0	0	0	0
ACMI	0	r	0	0	r	0	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r	0	r
ANHO	0	r	0	0	0	r	0	r	0	0	0	+	r	r	+	0	0	0	0	0	0	0	r	0	r	0	0	0	0	r
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	r
SEST	0	r	0	0	0	0	r	0	0	0	0	0	r	r	r	r	0	0	0	0	0	0	0	r	r	r	r	r	r	r
SOSP	r	0	r	r	r	r	+	+	+	r	r	r	+	+	+	r	r	0	0	0	r	r	r	0	r	0	r	r	r	r
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	r	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0	0	0
CARO	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
GEAM	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	r	r	r	0	r	0	0	0	0	0	0	0	0	0	r	r	r	0	r	r	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	3	4	8	17	16	9	12	11	9	11	10	8	8	8	11	4	2	3	5	7	8	9	6	3	4	5	5	4	5
FESA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	+	+	+	+	r	0	0	0	0	0	+	0	0	r	+	+	2	2	+	0	0	0	0	+	r	0	r	0
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	4	2	7	0	5	2	0	0	+	2	+	r	2	r	r	r	0	2	13	15	5	2	+	r	0	0	+	0	2	0
PLSC	35	41	16	2	+	4	+	0	r	2	0	r	4	+	0	0	+	2	41	35	21	+	+	+	0	0	+	2	2	0
POJU	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	r	0	0	r	r	0	0	0
CLADONIA	0	0	0	0	0	0	0	r	0	0	0	r	r	r	r	0	0	r	0	0	r	0	0	0	0	r	0	0	0	r
PELT.	4	+	7	2	4	+	5	10	6	6	0	7	2	9	8	11	8	9	10	8	6	2	0	9	21	0	+	2	5	3
STEREO.	+	r	r	0	0	0	0	0	0	r	+	r	+	r	2	r	r	+	0	r	0	0	+	0	0	2	r	2	2	r

Table B-2. continued (Athabasca understorey 1989)

Species	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
SMCA	3	10	2	5	+	2	2	4	25	19	15	7	9	21	17	3	2	21	4	r	2	16	9	5	6	16	6	4	5	4
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	r	r	+	r	2	r	r	r	2	r	0	0	r	r	r	2	r	+	+	+	+	2	r	r	+	6	0	+	r
ROAC	3	4	3	+	0	r	r	+	0	+	r	2	2	2	+	+	2	4	+	+	+	+	+	+	2	+	2	+	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r
ARUV	28	19	35	19	17	22	23	37	10	12	5	11	16	12	15	21	20	28	18	25	22	18	12	25	19	13	18	27	25	15
LIBO	0	+	0	0	2	+	0	4	5	+	15	8	18	18	13	0	0	0	0	0	+	10	15	+	7	14	19	14	5	23
JUHO	0	r	0	+	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
FRVI	+	+	+	+	+	+	+	2	+	+	+	+	r	+	+	+	+	+	r	+	2	+	2	+	2	+	r	2	2	3
ORSE	0	0	0	0	0	0	0	0	r	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r
PYCH	0	r	0	r	r	0	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	r
ACMI	r	r	r	r	r	0	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r
ANMO	r	+	r	0	r	0	r	r	0	0	+	0	0	0	r	0	0	0	+	r	r	0	0	r	r	0	0	0	r	0
ANRO	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	r	0	0	r	r	0	0	0	0	r	0	0	0	r	r	r	r	r	r	r	r	r	r	0	0	0	0	0
SOSP	r	r	r	r	r	r	r	r	0	r	r	r	0	r	r	r	0	r	+	+	r	r	0	r	r	0	0	0	0	0
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	r	r	0	r	r	0	r	0	0	r	0	0	0	r	0	0	0	r	0	0	r	r	r	0	0	0	r	+
CARO	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	0	r	r	0	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	6	7	11	9	5	8	8	8	6	3	9	2	4	7	8	9	5	14	11	7	9	6	9	8	5	4	7	9	9
FESA	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	+	0	0	0	0	0	0	0	0	0	r	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	+	r	r	+	0	0	0	r	+	+	+	+	+	r	0	0	0	0	0	0	r	+	0	r	+	2	3	+	+
DIUN	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0
HYSP	+	+	0	+	+	0	0	0	2	3	6	8	6	4	0	0	0	r	0	0	+	r	+	r	r	+	7	4	9	r
PLSC	+	+	r	2	2	0	0	0	23	28	26	22	28	11	0	0	0	r	0	r	0	+	+	r	+	2	39	15	20	16
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0
CLADINA	r	r	0	0	0	r	0	0	0	0	r	r	0	r	r	0	3	0	+	0	+	0	0	0	0	0	r	r	0	r
CLADONIA	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	r	0	r	0	0
PELT.	9	11	4	8	4	17	19	7	+	6	+	4	10	5	6	5	5	2	5	6	3	3	2	+	2	2	4	8	+	5
STEREO.	+	r	0	r	+	r	+	0	0	r	r	0	0	+	+	2	2	2	3	2	2	r	+	+	r	+	0	r	r	r

Species	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
SMCA	+	17	+	2	0	2	2	3	+	+	3	2	3	5	3	+	+	0	10	11	4	17	21	3	20	3	16	17	4	7
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	2	0	r	9	r	r	35	25	+	r	2	2	r	r	2	0	r	r	10	+	r	r	r	r	r	2	0	r	6
ROAC	+	+	+	2	+	2	3	0	2	5	6	3	+	+	+	+	+	0	+	2	+	+	r	r	r	+	2	2	2	+
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0
ARUV	8	21	20	28	22	25	10	23	30	22	21	26	13	8	27	19	23	23	20	17	18	3	9	5	19	30	32	20	34	32
LIBO	3	+	12	0	2	2	11	0	0	0	0	0	18	30	5	20	10	+	15	6	9	8	5	3	7	5	5	6	3	0
JUHO	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	3	2	+	2	2	3	2	r	r	r	+	r	+	+	2	2	2	2	2	4	2	r	r	r	r	+	2	+	+	r
ORSE	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	r	0	0	0	0	0
PYCH	r	r	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	r	0	r	0	r	r	r	0	r	r	r	0	0
ACMI	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	0	0	0	0	0	r	r	r	r	r
ANMO	r	+	r	r	r	r	0	0	0	r	r	0	0	0	r	r	r	0	r	0	0	0	0	0	0	r	r	0	0	r
ANRO	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	r	r	r	0	r	0	0	r	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0	0	0	r	r
SOSP	0	r	r	r	+	0	r	r	r	r	0	0	r	0	r	0	r	r	r	0	0	0	0	0	0	0	0	r	r	r
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	r	r	r	0	r	r	r	0	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	r	0	r	r	r
CARO	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	r	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	6	9	6	8	4	10	11	4	7	7	7	8	8	6	7	6	7	6	10	6	4	4	2	4	8	7	7	9	0	8
FESA	0	0	0	0	0	0	0	0	r	+	+	r	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	+	+	0	+	r	r	0	+	r	0	0	0	r	+	r	2	r	0	+	+	+	5	r	+	r	0	r	r	0	0
DIUN	0	0	0	0	0	0	0	+	+	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	r
HYSP	2	3	3	+	+	+	14	15	+	0	0	0	3	2	0	2	0	0	2	+	5	3	2	4	4	2	0	r	0	0
PLSC	25	7	3	+	2	2	23	5	2	r	+	r	13	2	+	2	+	0	3	17	71	28	74	71	43	26	r	r	0	+
POJU	0	0	0	0	0	0	0	r	0	0	r	r	r	0	r	r	r	r	r	0	0	0	0	0	r	0	0	r	0	0
CLADINA	r	r	0	0	r	r	0	0	r	+	0	0	0	0	r	0	0	0	0	0	r	0	0	r	0	r	r	0	0	0
CLADONIA	r	r	r	r	0	0	r	r	r	r	+	r	0	r	r	r	r	r	r	r	r	r	0	r	0	r	r	r	0	r
PELT.	4	5	3	5	4	3	7	2	5	2	2	+	0	2	3	4	3	+	5	6	2	4	4	5	5	2	4	2	2	+
STEREO.	r	r	+	0	+	r	r	+	r	2	+	r	+	r	2	+	r	r	2	0	+	r	0	0	0	+	r	r	+	2

Table B-2. continued (Athabasca understorey 1989)

Species	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
SHCA	4	8	30	18	16	23	15	21	23	3	8	12	+	16	16	+	2	3	3	2	+	0	10	+	2	11	0	+	2	11
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
JUCO	2	0	3	+	r	r	r	5	+	2	r	r	r	r	+	r	r	r	4	4	+	9	0	26	r	0	0	+	0	0
ROAC	2	3	2	3	5	3	+	+	+	4	2	2	2	2	+	+	3	2	+	r	+	+	0	+	+	2	4	3	3	12
SALIX	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	36	34	35	23	20	25	14	22	20	29	30	27	30	27	35	33	31	32	39	29	44	33	43	20	40	42	41	38	29	28
LIBO	6	8	14	12	9	5	6	4	2	16	2	4	9	15	10	3	15	14	0	3	0	0	3	4	2	15	3	13	30	4
JUHO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
FRVI	2	+	2	2	2	+	r	+	3	+	3	+	2	+	2	2	+	+	r	r	r	+	+	+	+	+	3	+	+	2
ORSE	0	0	0	0	r	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	r	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
ACMI	r	r	r	r	r	r	r	0	r	0	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r	r	r
ANHO	r	r	0	r	0	0	0	0	0	0	r	+	r	r	0	0	0	0	r	r	+	+	0	0	0	r	0	0	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	0	0	r	0	0	0	0	0	r	r	r	r	0	0	0	0	r	r	r	r	r	r	0	0	r	r	r	r
SOSP	r	0	r	r	0	0	0	0	0	0	r	r	r	r	r	0	r	r	r	r	r	r	r	0	0	r	0	0	r	r
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	0	0	0	0	0	r	r	0	0	r	0	r	r
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	0	0	0	r	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	r	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	r	0	0	0	0
ELIN	7	8	9	6	6	4	5	4	5	5	8	8	8	6	7	9	7	7	8	7	6	5	7	3	5	9	9	9	10	8
FESA	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	+	r	r	+	r	r	0	0	0	0	r	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
DIPO	0	0	r	r	r	r	2	0	+	r	r	r	0	r	r	r	r	r	r	r	0	0	r	+	+	+	+	r	+	+
DIUN	0	0	0	r	0	0	0	0	0	r	0	0	0	r	r	0	0	0	r	0	0	0	0	+	+	0	0	0	r	r
HYSP	r	0	+	5	6	4	3	3	3	r	+	+	0	0	r	r	r	+	r	r	r	r	2	3	r	r	0	r	+	2
PLSC	r	r	2	17	30	43	61	51	45	6	+	7	+	+	+	r	r	3	r	r	r	r	5	14	+	+	0	+	4	5
POJU	0	r	r	0	r	0	0	0	0	0	0	r	0	r	0	0	0	r	0	r	r	r	r	r	r	r	0	r	r	r
CLADINA	0	r	0	0	r	r	r	r	r	0	+	r	r	0	r	0	0	r	0	r	r	0	0	r	0	0	0	+	r	r
CLADONIA	r	0	r	0	r	0	0	r	0	r	r	r	r	r	r	r	r	r	+	+	+	+	0	r	r	0	0	r	r	r
PELT.	+	+	2	3	5	+	+	+	4	5	3	3	3	4	7	4	3	2	0	3	+	4	2	4	6	12	5	5	2	5
STEREO.	3	+	+	r	r	r	0	r	+	r	2	+	2	+	r	+	+	r	r	+	+	2	r	r	+	+	3	+	r	+

Species	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SHCA	15	16	14	10	19	14	22	8	15	r	0	9	13	22	18	15	3	10	11	2	2	2	3	4	2	4	+	10	2	r
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
JUCO	0	3	0	0	3	r	r	3	r	r	2	+	10	5	r	+	5	r	0	r	0	r	0	9	2	0	8	40	0	5
ROAC	6	3	3	3	10	4	3	3	3	4	5	3	4	3	3	3	3	3	+	+	5	5	3	6	3	3	2	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	27	28	39	30	41	28	18	22	25	22	29	23	21	20	21	31	33	21	42	40	38	31	35	30	53	31	29	24	16	39
LIBO	4	4	3	+	6	8	3	6	10	3	2	10	20	18	5	0	4	29	4	2	0	5	9	8	8	0	0	0	11	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	2	2	2	2	3	+	2	2	3	2	2	2	+	2	2	2	2	+	+	+	+	r	2	+	+	+	+	+	+	2
ORSE	r	r	0	0	0	r	r	r	r	0	r	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	r	r	r	r	r	r	r	r	0	0	0	r	0	0	r	0	0	0	r	r	0	0	0	0	r	0	0	0	0
ACMI	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	r	r	r	r	r	r	r	r	r	r	0	r	+	r	r
ANHO	0	0	r	r	r	r	0	r	0	+	+	r	0	0	r	r	0	0	0	r	r	r	r	r	0	+	r	r	r	r
ANRO	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
SEST	r	0	r	r	0	r	r	r	r	r	r	r	r	r	0	0	r	0	0	r	+	r	r	r	r	0	0	0	+	r
SOSP	0	0	r	r	r	0	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	0	r	r	0	r	0	0	r	r
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	0	r	r	0	r	0	r	0	r	0	r	0	0	0	0	0	r	r	r	r	r	r	r	0	0	0	0	0	0
CARO	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	r	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
ELIN	9	5	11	10	8	7	7	7	9	12	10	10	7	6	7	8	8	10	7	8	9	9	10	9	7	7	7	7	6	7
FESA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	+	r	r
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
DIPO	r	+	r	r	r	+	r	r	+	+	0	+	2	2	+	0	0	r	r	0	r	0	0	r	r	r	r	0	r	0
DIUN	r	r	r	r	r	0	0	0	0	r	0	r	r	r	0	r	r	0	r	r	0	r	r	r	0	r	r	r	5	0
HYSP	r	+	+	+	3	13	10	+	+	2	2	2	8	10	7	+	2	2	0	r	0	0	r	+	r	+	r	2	0	+
PLSC	2	+	3	+	4	12	13	2	+	2	+	3	27	31	20	3	2	4	r	r	0	0	r	2	r	+	+	+	17	r
POJU	0	+	r	r	r	0	0	0	0	0	r	0	0	0	r	0	r	0	0	r	0	+	0	0	0	r	r	r	r	r
CLADINA	0	r	0	0	0	0	r	0	0	0	0	r	0	0	0	+	r	r	0	0	0	r	r	r	0	0	0	0	0	+
CLADONIA	r	r	r	r	0	0	r	r	r	r	r	0	0	0	r	0	r	2	0	r	r	r	0	0	0	r	+	r	r	r
PELT.	4	4	3	2	+	2	2	+	2	3	2	4	7	5	2	3	11	4	r	2	2	6	8	4	2	7	5	2	4	7
STEREO.	r	r	r	0	+	0	r	+	r	2	r	3	0	r	+	2	+	r	r	2	+	r	+	3	r	r	r	3	2	+

Table B-2. continued (Athabasca understorey 1989)

Species	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
SHCA	6	2	5	8	6	r	8	3	2	2	3	10	5	2	7	14	21	20	15	4	6	12	22	10	15	18	3	17	2	16
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	10	35	0	0	0	10	0	0	r	40	3	r	r	r	r	0	3	3	r	r	0	r	+	4	r	0	0	r	r	r
ROAC	4	3	2	3	+	+	2	3	7	5	4	5	4	4	5	6	5	4	5	5	11	7	11	12	18	13	7	8	5	4
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	28	28	35	25	39	48	37	29	27	30	22	32	28	31	28	31	26	27	25	27	53	51	55	50	40	53	48	30	39	38
LIBO	0	0	0	0	+	0	0	3	+	5	0	2	8	3	3	5	5	7	6	0	+	15	10	11	9	6	3	35	10	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	3	+	4	+	2	2	3	2	3	2	2	2	2	2	2	+	2	3	2	+	+	3	3	3	2	3	2	2	3	4
ORSE	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	r	r	0	r	0	0
ACMI	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r
ANHO	r	0	0	0	r	r	0	0	0	0	r	r	0	0	+	0	r	r	r	+	r	r	r	0	0	r	0	0	0	0
ANRO	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	+	r	r	0	r	r	r	r	r	r	r	r	r	0	0	0	0	r	0	0	0	0	+	0	r	r	r	+
SOSP	0	0	r	0	0	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	0	0	0	r	r	0	0	r	r
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	0	r	0	0	r	+	r	0	r	r	r	r	r	r	r	0	0	r	r	r	r	0	0	r	0	r	r	r	r
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	r	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0
ELIN	8	8	9	8	8	7	9	17	9	7	8	9	9	7	9	7	6	7	9	9	9	8	8	8	8	8	9	9	9	10
FESA	0	0	+	2	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	0	0	0	r	r	+	r	r	r	r	r	r	r	r	r	r	2	r	r	+	r	0	+	r	r	r	r	0
DIUN	0	r	0	0	0	0	5	r	+	0	r	r	0	r	0	r	0	0	r	0	0	r	r	+	0	0	0	0	r	0
HYSP	2	8	0	0	0	0	r	2	2	2	+	0	2	2	12	14	15	15	10	3	3	13	+	+	14	4	0	+	0	0
PLSC	r	4	0	+	0	0	r	2	3	8	+	0	2	r	10	21	22	23	15	2	8	22	2	2	21	8	0	+	0	0
POJU	+	0	r	+	r	0	0	0	r	0	0	0	r	0	0	0	r	r	0	r	0	0	0	0	r	r	0	r	r	r
CLADINA	+	0	r	r	0	0	0	+	0	0	r	0	0	r	r	0	r	0	0	r	r	r	r	+	r	0	0	0	r	r
CLADONIA	+	r	r	r	r	r	0	r	r	r	3	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r
PELT.	4	4	4	3	4	3	+	0	7	10	5	10	4	6	8	4	5	+	2	+	4	6	6	5	6	5	5	6	4	11
STEREO.	+	+	r	0	+	+	0	r	+	2	5	r	+	r	2	r	r	r	+	+	+	+	0	r	r	+	+	+	2	+

Species	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
SHCA	+	2	17	+	+	2	4	8	13	9	r	+	2	6	9	8	12	3	2	3	4	+	3	+	3	16	15	14	3	7
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	+	0	0	+	0	0	0	0	0	0
JUCO	61	3	6	0	r	r	0	0	r	18	+	0	0	0	0	r	0	3	0	4	0	r	3	3	0	0	2	r	+	0
ROAC	3	4	5	+	5	2	5	7	5	3	5	7	5	2	8	6	2	3	2	4	3	3	2	5	6	9	7	2	13	15
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	21	56	41	42	44	29	43	29	38	23	26	36	44	48	36	24	28	51	42	39	32	33	35	48	51	41	39	40	48	38
LIBO	25	3	6	0	2	2	8	27	10	2	0	r	7	8	12	20	3	0	0	0	3	0	0	5	5	9	15	7	0	8
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	2	2	4	4	5	3	2	2	2	3	5	5	4	2	4	5	0	3	3	5	6	4	+	3	3	2	r	+	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0
PYCH	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ACMI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	0	0	r	r	r	0	r	0	0
ANHO	r	0	+	+	0	r	+	0	0	r	+	r	0	0	0	r	+	+	r	r	0	r	+	r	r	0	0	0	0	0
ANRO	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	+	+	r	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	0	0	+	+	+	r	r	0	r	r	r	+	0	r	r	0	r	+	+	+	+	r	r	r	0	0	0	0
SOSP	r	+	0	+	r	r	0	0	0	0	r	r	r	0	r	r	+	+	r	r	r	r	r	0	r	r	r	0	0	0
TAOF	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	r	r	0	r	r	r	r	0	0	0	0	r	r	r	r	r	r	0	r	r	0	r	r	r	r	r	r	r	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	0	0	0	0	0	r	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	r	r	0	r	0	r	r	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	r	r	0	r	r	r	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	+	0	0	0	0	0	0	0
ELIN	6	9	4	9	8	10	10	10	10	7	10	11	11	9	10	8	9	10	9	9	7	10	9	7	8	8	7	8	9	8
FESA	0	0	0	0	0	r	r	0	0	+	0	0	0	0	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	r
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	r	0	r	0	r	+	r	r	r	r	0	r	+	r	0	0	0	0	r	0	0	r	+	+	r	+	+	+
DIUN	0	0	r	r	r	0	r	r	0	0	r	0	r	r	r	0	r	r	r	r	r	0	0	0	r	0	0	r	r	r
HYSP	5	2	5	3	+	+	+	4	6	2	3	+	+	+	6	5	+	r	0	+	+	3	+	r	2	5	4	6	7	7
PLSC	6	3	+	+	+	0	+	3	6	2	3	+	+	+	9	6	+	0	0	+	+	3	+	r	r	7	6	5	8	6
POJU	r	0	0	0	r	+	r	r	0	0	0	0	0	r	r	r	r	0	r	0	r	r	0	0	0	r	r	0	r	r
CLADINA	r	r	+	0	+	3	2	0	+	r	0	0	+	+	+	r	r	0	r	0	+	0	0	0	r	+	r	0	0	0
CLADONIA	+	r	r	r	1	+	+	r	+	r	+	r	+	r	r	+	+	r	0	+	+	+	r	+	+	r	r	0	+	0
PELT.	4	6	6	4	4	3	4	4	4	4	3	3	5	7	8	3	6	+	2	16	5	6	3	4	7	6	5	5	4	5
STEREO.	+	+	2	+	+	3	r	+	3	r	2	2	+	r	+	2	2	+	+	3	4	2	r	+	2	+	r	r	r	r

Table B-2. continued (Athabasca understorey 1989)

Species	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
SHCA	4	7	8	5	+	+	4	2	9	2	5	11	3	3	+	4	2	4	0	2	2	3	4	7	10	+	3	4	3	2
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	5	0	0
JUCO	0	7	r	+	r	r	+	8	0	17	62	0	0	r	0	8	r	5	6	3	2	0	r	0	r	20	r	r	4	r
ROAC	8	8	8	10	6	7	6	3	5	5	3	5	6	4	5	3	4	3	6	6	5	5	4	5	6	4	9	3	5	2
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	28	28	25	36	53	48	52	33	35	29	20	45	27	34	22	45	25	20	48	41	48	25	26	44	23	39	22	26	38	23
LIBO	9	12	7	2	4	8	7	5	10	+	6	17	15	8	30	+	0	7	+	7	5	10	7	0	11	12	17	11	13	6
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	3	+	0	2	2	3	3	5	3	3	4	3	4	3	4	2	4	5	2	3	3	5	6	3	3	3	2	+	+	4
ORSE	0	0	r	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	r	0	0	r	0	0	r	0	r	r	0	0	0	r
ACMI	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r
ANHO	r	+	r	0	r	r	r	0	+	r	r	+	r	r	0	0	0	r	+	r	r	+	r	0	0	0	0	+	+	r
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	0	0	r	r	r	0	+	r	r	r	+	2	0	0	r	+	+	r	r	r	r	+	r	0	0	r	r	0
SOSP	0	r	r	r	r	r	r	r	r	0	r	+	0	r	r	r	r	r	r	r	0	0	0	0	r	0	r	r	r	r
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	r	r	r	r	r	r	r	0	0	0	r	r	r	0	r	r	r	0	0	0	r	0	r	r	r	r	r	r	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	r	r	r	0	0	0	0	0	0
GEAM	0	r	0	0	0	r	0	0	0	r	r	0	0	r	r	0	0	r	r	0	0	0	0	0	0	0	r	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	+	0	r	0	r	2	0
ELIN	8	7	7	8	7	9	8	9	7	9	7	9	11	9	7	9	8	10	10	8	10	10	11	9	10	8	7	10	10	7
FESA	r	0	0	0	0	0	0	0	0	0	0	0	+	+	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
CAREX	0	0	0	0	0	0	0	+	0	+	0	0	0	0	0	0	0	0	r	r	0	r	r	0	0	0	0	1	+	0
DIPO	+	+	r	+	+	+	r	+	+	0	0	+	r	+	+	r	2	r	r	r	r	0	r	r	+	r	0	r	r	+
DIUN	r	r	r	0	0	r	4	0	0	r	0	0	0	0	0	r	0	0	r	0	0	0	0	r	0	0	0	0	r	0
HYSP	15	8	5	5	3	3	0	3	4	7	45	4	5	2	2	2	3	8	2	0	r	2	+	2	2	4	5	4	4	5
PLSC	12	5	6	6	0	3	r	11	5	r	4	5	4	+	0	6	2	3	0	0	r	2	r	r	3	4	0	2	3	2
POJU	0	r	r	r	0	0	r	r	r	r	0	r	0	0	0	r	r	r	0	0	r	r	r	0	0	r	r	r	r	r
CLADINA	0	r	0	+	2	0	0	0	0	0	0	r	+	r	0	0	r	0	0	0	0	+	0	0	+	0	0	0	0	0
CLADONIA	r	r	0	r	r	r	1	0	r	2	2	+	r	+	0	0	+	+	r	r	+	r	r	+	r	+	r	+	+	+
PELT.	12	6	6	4	3	3	7	6	9	10	8	7	6	4	6	10	12	6	3	6	3	8	2	4	10	6	9	2	7	8
STEREO.	+	+	+	+	0	+	+	+	+	0	3	r	+	2	r	r	r	2	0	2	2	r	r	0	r	+	2	r	r	+

Species	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
SHCA	3	11	21	+	3	2	3	4	3	18	5	11	7	3	2	4	+	21	12	5	3	+	0	3	5	4	r	+	3	5
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	r	0	0	0	0	0	0
JUCO	0	r	8	2	r	r	0	7	0	3	3	0	r	0	+	r	+	r	2	0	0	2	0	0	0	0	0	r	2	19
ROAC	6	5	4	2	6	5	5	4	3	3	4	6	4	5	7	2	3	2	3	5	2	2	+	4	4	2	r	r	r	0
SALIX	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	21	36	62	38	45	35	37	28	18	13	28	26	26	30	23	33	41	25	19	19	21	17	17	21	26	16	15	18	15	11
LIBO	4	2	3	2	10	11	12	6	+	+	3	3	+	+	9	5	0	2	+	0	0	2	2	+	5	3	0	+	4	r
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	4	6	4	2	5	3	r	3	+	+	0	r	2	+	2	2	3	+	2	2	r	+	+	+	3	2	4	+	3	2
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	r	0	0	r
ACMI	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	+	r	r	0	r	r	r	r	r
ANHO	0	r	0	+	r	0	0	0	0	0	0	0	r	0	0	r	r	0	r	r	+	+	+	r	0	0	r	r	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0
SEST	r	r	r	+	r	0	0	0	r	r	0	0	0	0	0	r	r	0	r	r	r	r	0	r	r	0	r	r	r	0
SOSP	r	r	0	r	r	r	r	0	0	r	r	r	r	0	0	r	r	0	r	r	r	0	0	0	0	0	0	r	0	0
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	r	r	r	0	0	0	r	0	0	0	r	r	0	r	0	0	r	r	r	0	0	r	0	0	r	r	0
CARO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GEAM	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0
VIAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0
COTR	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r	r	0	0
ELIN	8	6	4	9	8	7	8	6	7	8	6	6	7	9	8	7	9	8	6	8	11	10	4	5	7	7	6	8	9	3
FESA	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	r	0	0	r	r	0	0	r	r	r	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	1	+	0	r	r	+	+	r
DIPO	r	+	r	r	r	+	r	r	+	r	r	r	r	r	r	r	0	r	+	r	0	r	r	r	0	r	r	0	r	0
DIUN	0	r	0	0	0	0	r	0	0	0	0	r	0	r	0	0	0	0	r	r	0	0	0	r	r	0	r	r	r	0
HYSP	5	4	3	r	2	2	3	2	2	3	r	3	+	3	6	+	r	2	3	5	+	+	+	0	3	+	+	r	2	7
PLSC	6	5	3	+	+	2	4	5	7	10	2	7	3	9	3	2	r	5	5	9	r	r	+	r	3	2	r	r	2	13
POJU	0	0	0	r	r	r	r	r	0	r	r	r	0	r	r	r	0	0	r	r	0	0	0	r	r	r	r	r	0	r
CLADINA	r	r	0	0	r	0	r	r	r	r	0	0	r	0	0	r	r	0	r	+	r	r	0	0	0	0	0	0	0	0
CLADONIA	r	r	r	r	r	r	r	r	r	0	r	r	r	0	r	r	0	r	r	r	r	r	r	0	r	0	r	r	r	r
PELT.	3	3	+	5	3	4	4	3	5	8	4	3	2	6	6	9	2	2	3	5	6	3	2	2	3	2	4	4	4	3
STEREO.	r	r	r	r	+	r	r	+	r	r	+	+	+	+	+	r	+	+	+	0	+	r	0	r	+	r	2	r	+	0

Table B-2. continued (Athabasca understorey 1989)

Species	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
SHCA	2	13	2	3	7	4	+	+	+	2	r	2	3	3	2	7	2	5	5	15	12	5	3	7	7	3	7	2	r	2
LODI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	r	r	0	3	0	r	r	0	8	0	0	0	+	5	2	0	0	0	8	2	r	0	5	0	3	0	0	16	0
ROAC	0	0	0	r	+	2	3	3	5	+	3	+	r	r	3	6	5	4	3	5	6	3	6	4	5	5	2	+	+	r
SALIX	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	2	22	18	26	15	3	29	27	24	21	5	33	37	26	24	20	26	23	30	37	42	40	27	21	20	26	18	22	13	19
LIBO	2	2	10	+	4	6	4	6	5	6	0	0	0	0	+	13	3	8	7	2	+	5	5	3	5	3	4	2	r	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	2	2	4	4	3	r	0	+	2	4	2	3	3	2	+	r	+	+	r	+	2	+	+	0	+	2	2	2	+	r
ORSE	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0	0	0	0	0	0	0	0
PYCH	r	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	r	r	0	0	0	0	0	0
ACMI	0	r	r	r	0	0	0	0	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r	0
ANHO	0	0	r	+	r	0	0	0	0	r	+	r	0	r	0	0	0	0	0	0	r	0	0	0	r	0	r	0	+	+
ANRO	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	r	0	r	0	0	0	0	r	r	r	+	0	r	r	0	0	0	r	0	0	0	r	r	r	0	r	r	r	r
SOSP	0	r	0	r	0	0	0	r	0	r	r	r	r	r	r	r	r	0	0	0	r	0	0	r	0	r	r	r	r	0
TAOF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	r	r	r	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r
CARO	0	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	r	0	0	0	0	0	r	0	0	0	0	0
VIAM	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	r	0	r	0	0	0	r	r	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
ELIN	4	8	9	7	7	8	5	5	9	8	9	9	8	7	7	6	9	6	5	6	7	5	6	6	6	6	6	8	4	8
FESA	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0
CAREX	0	0	+	r	0	0	0	0	0	r	r	r	0	0	0	0	+	0	0	0	0	0	0	0	r	0	0	r	+	r
DIPO	r	r	0	0	r	r	r	r	r	r	0	0	0	r	r	r	r	r	r	r	0	r	r	r	r	r	+	0	0	0
DIUN	0	2	r	0	0	0	0	0	0	r	r	0	0	0	r	0	+	0	r	0	0	0	0	r	0	r	0	r	r	r
HYSP	6	9	+	r	2	2	+	2	r	+	r	0	0	+	2	+	0	5	2	2	2	15	7	8	+	8	4	r	r	0
PLSC	63	22	2	+	2	2	2	2	2	+	r	0	0	+	4	+	0	8	5	3	2	15	8	2	2	15	3	r	r	0
POJU	0	0	0	0	0	0	0	r	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r
CLADINA	0	0	0	r	0	r	0	0	r	r	0	r	0	0	r	0	0	0	0	0	0	r	0	0	0	r	0	r	r	r
CLADONIA	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r
PELT.	+	3	3	7	2	+	3	6	4	5	2	4	2	5	5	3	7	6	4	2	5	4	6	6	7	4	7	4	22	25
STEREO.	0	+	2	+	+	+	0	+	r	r	+	+	0	r	r	+	r	r	r	r	r	0	r	r	2	r	r	r	+	0

Species	391	392	393	394	395	396	397	398	399	400
SHCA	7	8	8	r	2	5	r	10	2	2
LODI	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0
JUCO	0	r	0	0	0	+	2	0	+	r
ROAC	0	3	+	2	2	2	r	3	0	0
SALIX	0	0	0	0	0	0	0	0	r	r
ARUV	21	26	14	24	31	28	13	17	2	+
LIBO	3	+	8	2	0	+	5	7	2	2
JUHO	0	0	0	0	0	0	0	0	r	r
FRVI	0	r	2	+	3	3	5	r	+	+
ORSE	0	r	r	0	0	0	0	r	0	r
PYCH	0	0	0	0	0	0	0	r	r	0
ACMI	r	r	r	r	r	r	r	r	0	r
ANHO	+	r	r	r	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0
SEST	r	r	r	r	r	0	0	0	0	r
SOSP	r	r	0	r	r	r	0	0	0	0
TAOF	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0
VIAD	r	r	0	r	r	0	0	r	0	0
CARO	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	r	0	0	0	0	0	0
VIAM	0	0	0	0	0	0	0	0	0	r
TRRE	0	0	0	0	0	0	0	0	0	0
ANMU	0	0	0	0	0	0	0	0	0	0
CABU	0	0	r	0	0	0	0	r	0	0
COTR	0	0	0	0	0	0	0	0	0	0
HAVI	0	0	0	0	0	0	0	0	0	0
CAPU	0	0	0	r	+	0	0	0	0	0
ELIN	7	8	9	8	8	8	7	7	6	2
FESA	0	0	0	0	0	0	0	0	0	0
CAREX	r	r	r	0	0	r	0	0	0	0
DIPO	0	0	r	r	0	0	r	r	+	r
DIUN	0	0	0	r	0	r	r	0	0	0
HYSP	0	0	2	+	0	0	3	16	21	33
PLSC	0	r	3	0	0	0	3	8	40	40
POJU	r	r	0	0	0	0	0	0	r	0
CLADINA	0	0	0	0	r	r	r	0	0	0
CLADONIA	r	0	0	r	r	0	r	r	r	0
PELT.	12	7	6	7	2	5	9	3	3	2
STEREO.	r	0	0	0	r	r	r	0	0	0

Table B-3. Understorey species cover estimates for Sunwapta 1967

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SNCA	1	1	1	0	3	1	2	2	2	3	1	1	+	+	2	2	3	2	+	2	4	4	4	3	+	+	1	1	+	+
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
MEPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	+	1	0	0	r	r	r	r	+	r	+	1	0	r	r	r	+	r	r	r	r	+	r	r	1	+	1	+	+
ROAC	+	+	+	+	+	r	r	r	r	+	+	+	r	+	+	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	+	+	0	0	r	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+
ARUV	0	0	0	r	+	r	1	r	r	+	+	+	+	+	+	+	+	r	+	r	+	r	r	+	r	r	r	+	0	+
LIBO	+	+	+	r	r	1	2	+	r	r	r	r	r	r	1	+	1	+	+	+	1	+	1	2	1	+	+	+	+	+
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	r	r	r	+	r	+	r	r	+	r	r	r	r	r	+	r	r	+	+	+	+	+	+	+	+	+	+	+	r	r
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
VASC	r	r	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	+	+	r	r	0	0	0	0	0	0	0	0
VAVI	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	r	r	+	+	0	0	r	0	0	0	0	0	0	r	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	r	r	+	0	0	r	r	r	r	r	r	r	r	r	+	r	+	+	r	+	+	r	r	r	+	r	r	r
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	r	r	r	r	r	0	0	0	r	r	0
ORSE	r	r	0	0	0	0	r	r	r	r	r	r	0	0	0	0	+	r	r	r	r	+	r	0	r	0	r	r	r	0
PYCH	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
COCA	+	r	r	+	0	r	r	r	r	0	0	0	0	r	0	0	r	r	+	+	+	+	+	+	r	0	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	r	0	r	0	r	0	0	r	r	r	r	r	r	r	r	r	r	r	+	r	0	0	0	r	r	r	r	0	r	r
ANRO	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	r	r	0	0	r
ARCO	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	+	r	r	r	r	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0	r	0	0	0	0	0	r	0	0
ASCO	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	+	r	r	+	+	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	r	r	0	0	0	0	0	0	r	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
SOSP	r	r	r	r	r	r	0	0	0	r	r	r	r	r	r	r	r	0	0	0	0	0	0	0	0	r	r	r	r	r
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	0	r	0	0	r	r	0	r	0	0
MELI	r	+	r	r	+	+	r	r	r	+	r	+	+	+	r	+	r	r	r	r	0	r	0	0	r	r	+	+	r	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	r	0	0	0	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	0	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0
NAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	r	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	+	+	+	+	+	r	r	+	+	+	+	+	+	+	1	r	+	r	r	r	r	r	+	+	r	r	r	r	r
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
DIPO	r	r	r	+	r	0	0	r	0	0	r	r	r	r	r	r	0	r	r	r	0	0	0	r	0	r	r	r	r	r
HYSP	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	r	+	0	r	+	0	0	0	0	0	0	0
PLSC	+	+	+	r	0	r	r	+	r	r	r	r	+	r	r	+	5	6	6	5	4	4	4	+	r	+	+	2	1	r
POJU	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r
PTCR	+	r	r	0	0	+	+	0	r	r	r	r	r	0	0	r	+	+	1	r	r	+	1	r	0	0	+	+	+	0
CLADON.	+	+	+	+	r	r	r	+	+	+	+	+	+	+	r	+	r	r	+	+	r	r	0	r	r	r	r	r	+	+
PELT.	r	r	1	1	1	1	r	+	1	1	+	+	+	+	+	1	+	+	+	+	+	+	r	+	+	+	+	+	r	+
STEREO.	r	r	0	r	r	r	r	r	r	r	r	r	0	r	0	r	0	0	0	r	0	0	r	0	0	r	r	r	0	r

Table B-3. continued (Sunwapta understorey 1967)

Species	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
SHCA	+	+	r	+	1	+	+	+	1	1	2	2	3	1	2	+	2	1	r	1	0	+	3	2	2	2	2	4	4	4
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	+	0	3	r	0	0	r	+	+	+	1	1	1	+	r	1	r	+	r	+	0	0	+	1	+	r	r	0	0
ROAC	r	r	r	r	+	r	r	+	+	+	+	r	+	r	r	r	+	r	r	0	r	r	r	r	r	+	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+
ALCR	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	r	+	r	0	0	r	r	+	0	r	r	r	0	+	1	+	r	r	0	r	1	+	+	r	+	+	+	+
LIBO	0	r	r	+	1	+	r	+	+	+	+	+	+	+	+	+	r	+	+	+	r	+	+	+	+	+	+	+	+	+
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+
VACA	r	+	r	r	r	r	+	r	r	r	+	r	r	+	+	r	r	r	+	+	+	+	+	+	+	+	1	+	+	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	+	0	0	0	r	0	0	0
VAVI	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	+	+	r
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
FRVI	r	+	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	+	+	+	+	+	r
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	r	0	0	0	r
ORSE	r	+	0	0	r	r	0	0	r	+	+	r	+	r	+	0	r	r	r	r	r	r	+	+	0	0	r	r	r	r
PYCH	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
COCA	0	0	0	0	0	0	0	0	r	0	r	r	0	r	+	r	0	0	0	0	0	0	0	0	0	0	0	r	+	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	r	r	r	0	0	r	r	0	r	0	0	r	r	r	r	0	0	+	r	r	+	r	0	r	r	r	r	0	0	0
ANRO	0	0	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	r	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	+
ASCI	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	r	0	0
ASCO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	0	0	0	r	r	0	0	0	0	0	0	r	r	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0
SOSP	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	0	r	r	r	0	r	r	0	0	0	0	r
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	+	0	0	0
MELI	r	r	r	+	r	+	r	+	+	+	+	r	+	r	+	r	r	r	r	+	r	r	+	+	r	r	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r
GEAM	r	0	0	0	0	0	0	0	r	0	0	r	r	0	r	0	0	0	0	r	r	0	0	0	r	r	r	r	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	r	r	r	r	+	+	+	+	r	+	+	r	r	r	r	r	+	+	+	+	+	r	r	r	r	r	+	r	r
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	r	r	r	r	r	r	r	+	+	+	r	r	r	r	r	+	+	+	0	+	r	r	r	0	r	r	r
HYSP	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	r	0
PLSC	r	r	0	+	r	0	0	0	r	+	+	1	2	+	r	r	r	+	1	1	r	+	3	+	2	3	+	1	1	3
POJU	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0
PTCR	+	r	r	r	r	0	0	r	0	+	+	+	+	0	0	r	r	r	r	+	0	r	+	+	+	r	r	+	0	+
CLADON.	+	+	+	+	+	+	+	r	+	+	+	+	+	+	+	+	r	+	+	+	1	r	r	r	r	+	r	r	0	r
PELT.	+	r	r	r	1	r	r	r	1	1	+	r	+	+	1	+	+	r	+	+	r	r	r	1	r	+	+	+	2	+
STEREO.	r	r	r	r	0	+	r	r	r	0	0	r	r	r	r	r	r	r	0	r	r	r	0	r	0	0	0	0	0	0

Table B-3. continued (Sunwapta understorey 1967)

Species	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
SHCA	1	4	4	4	4	2	+	1	1	1	1	1	1	2	3	3	1	3	+	3	3	2	1	3	1	3	2	1	1	+
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	0	+	1	0	1	+	r	+	+	+	+	+	r	r	+	1	1	r	r	+	r	r	1	r	r	r	+	+	+
ROAC	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r	1	+	+	+	+	+	+	r	r	r	+	+	+	+	+
SALIX	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	+	r	+	+	+	+	1	+	r	r	+	r	+	r	0	r	r	0	+	+	r	r	+	r	+	+	+	+	+
LIBO	+	+	+	1	+	r	r	r	+	+	+	+	+	+	+	+	1	+	1	1	+	+	+	+	+	+	1	+	+	+
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	r	r	+	+	+	+	+	+	+	+	+	r	r	r	r	r	r	r	r	r	+	+	r	r	+	r	r	r	r	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	r	+	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	+	+	0	0	0	0	0	0	0
VAVI	r	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRVI	+	+	+	+	+	+	+	r	r	+	+	+	r	0	r	r	r	r	+	r	r	r	r	r	r	r	r	r	+	r
CHUM	0	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0
ORSE	0	r	r	0	0	r	0	0	0	r	0	r	r	r	r	r	0	+	+	r	r	r	r	0	r	0	r	0	r	0
PYCH	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
COCA	r	0	r	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	r	0	0	0	0	+	+	r	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	r	0	0	0	r	r	+	r	r	r	r	r	r	r	0	0	r	0	r	0	0	0	r	0	r	0	r	r	r	0
ANRO	r	r	0	0	0	0	0	r	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
ARCO	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	r	r	0	r	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	r	r	r	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	0
CAMI	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0
MELI	+	r	0	r	r	+	r	r	r	+	+	+	+	r	r	+	+	r	r	r	+	+	r	+	r	r	r	+	+	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	r	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	r	0	0	0	0	r	r	r	r	r	r	0	0	0	0	r	0	r	0	0	0	0	r	0	r	r	0	0	r	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	r	r	r	r	+	+	+	+	r	r	+	+	r	r	r	r	r	+	r	r	r	r	r	+	+	+	+	+	r
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	0	0	r	0	r	0	r	+	+	+	r	r	r	0	r	r	+	+	r	r	r	r	r	r	r	r	r	r
HYSP	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0
PLSC	4	5	4	+	1	+	0	0	r	+	+	+	+	+	r	r	r	r	1	3	+	+	r	r	+	1	r	+	+	r
POJU	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r
PTCR	0	r	+	+	r	r	0	0	0	+	+	+	+	+	0	0	r	r	+	1	+	+	r	0	0	0	r	r	+	r
CLADON.	r	r	r	r	+	r	+	r	+	+	+	+	+	+	+	r	+	+	+	+	r	+	+	+	+	+	r	+	r	r
PELT.	1	1	1	+	1	1	r	+	r	+	+	1	+	+	+	r	+	+	+	+	+	+	r	+	+	r	+	r	+	+
STEREO.	0	0	r	+	0	0	0	r	r	r	r	r	0	r	0	r	r	0	r	r	r	r	r	r	r	r	r	0	r	r

Table B-3. continued (Sunwapta understorey 1967)

Species	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SHCA	2	1	1	0	2	4	1	4	4	1	3	3	1	1	+	1	1	1	+	2	1	1	2	1	2	1	1	+	3	3
LBGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	3	r	+	+	0	0	r	+	r	r	r	r	r	+	r	+	2	0	0	+	r	1	+	+	+	+	+	r	1
ROAC	r	r	r	r	r	+	+	r	r	r	0	0	r	r	r	r	r	r	r	+	r	+	r	+	+	r	+	r	+	r
SALIX	0	0	0	0	0	0	0	0	r	r	+	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0
ARUV	+	r	+	+	+	+	+	+	r	r	r	r	0	+	r	r	r	r	+	r	+	+	r	+	+	+	r	0	r	r
LIBO	+	r	r	+	+	+	r	1	+	+	+	+	1	r	+	+	+	+	+	+	+	+	+	+	1	+	+	+	+	+
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
VACA	0	r	r	0	+	r	r	r	r	r	+	r	r	0	r	0	+	+	+	+	+	r	r	r	r	r	+	+	r	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0	0	0	0	0	r	r	+	+	+
VAVI	0	0	0	0	0	0	0	0	r	r	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	r	r	+	+	r	r	r	r	r	+	r	+	+	r	+	r	+	+	r	+	+	r	r	r	+	r	0	r
CHUM	0	0	0	0	0	+	r	+	r	0	r	r	0	r	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0
ORSE	0	+	0	r	r	r	0	0	r	0	0	0	0	0	0	r	r	r	r	r	r	r	0	0	r	r	r	r	+	r
PYCH	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r
COCA	+	0	0	0	0	0	0	+	+	r	+	r	r	0	0	r	+	0	0	0	0	0	0	0	0	r	r	r	r	0
ACMI	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	r	r	r	0	0
AGOS.	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	r	r	r	r	r	r	r	0	0	0	0	r	r	0	0	r	r	r	r	r	0	r	r	r	r	r	0	0	r	r
ANRO	r	r	r	r	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	0	r	r	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	r	r	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	0	0	r	r	+	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP	r	r	r	r	r	0	0	r	0	0	0	0	r	r	r	r	r	r	r	0	0	r	r	r	0	r	r	r	r	0
CAMI	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	r	r	0	0	r	r	0	0	0
MELI	r	r	+	r	r	+	+	r	r	+	+	+	+	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	r	r	r	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	r	r	r	r	r	r	r	0	0	r	0	r	r	r	0	r	r	r	r	r	0	0	0	r	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	r	+	r	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0
GOOB	0	0	0	0	0	r	r	0	0	0	r	0	0	0	0	r	r	r	0	0	0	0	0	0	0	r	r	r	r	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	+	+	+	+	1	r	r	r	r	r	+	r	r	r	+	r	r	+	r	+	+	r	r	r	r	r	r	r
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	0
DIPO	+	r	0	0	r	0	0	0	r	r	r	r	0	r	r	+	+	+	r	+	r	+	+	+	r	r	r	+	r	r
HYSP	0	0	r	0	r	0	0	0	r	0	0	0	0	0	0	0	r	r	0	0	0	0	r	0	0	0	0	0	0	0
PLSC	+	r	r	+	+	+	r	1	5	3	4	3	0	+	+	2	3	+	1	3	0	2	1	+	+	2	3	1	+	r
POJU	r	r	r	r	r	r	r	r	0	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0
PTCR	r	r	0	0	r	r	0	r	r	r	+	+	0	r	r	r	r	r	+	+	r	r	r	0	+	+	r	+	+	+
CLADON.	r	+	+	r	+	r	r	r	r	r	r	r	r	r	+	+	+	+	+	r	+	+	+	+	+	+	+	r	r	r
PELT.	+	r	+	+	+	1	1	+	r	r	1	+	+	+	+	+	r	r	+	r	+	r	r	+	+	r	r	r	1	1
STEREO.	0	r	r	0	0	0	r	0	r	r	0	r	r	r	0	r	r	r	r	r	r	r	0	r	r	r	r	0	r	r

Table B-3. continued (Sunwapta understorey 1967)

Species	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
SHCA	2	2	1	2	2	3	2	3	+	+	+	1	2	1	3	r	2	+	1	4	4	1	4	4	+	3	1	+	+	+
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	r	0	0	0	0	0	r	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	+	1	+	+	+	+	r	+	r	+	+	2	1	2	1	+	+	r	r	+	r	+	0	+	3	3	3	+	+
ROAC	+	r	r	r	r	r	+	r	+	+	+	+	+	+	r	r	r	r	r	r	0	r	r	r	r	r	r	+	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	+	r	r	r	r	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	+	r	r	r	+	+	+	r	+	+	+	+	+	+	r	+	r	r	+	r	r	r	+	+	+	r	+	r	r
LIBO	+	+	+	+	+	+	r	+	+	+	+	+	r	1	r	+	1	+	1	+	+	+	+	1	+	+	+	r	+	1
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	+	+	r	r	0	+	+	r	r	+	+	+	+	+	+	+	+	r	+	+	+	+	+	+	+	+	+	r	r	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
VASC	+	r	+	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	+	r	0	0	0	0	0	0	0
VAVI	0	0	0	0	0	0	0	0	0	0	0	r	+	0	0	0	0	0	r	+	r	r	0	0	0	0	0	r	0	0
JUNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	+	+	r	+	r	+	r	+	r	r	r	r	r
CHUM	0	0	0	0	0	0	0	0	0	r	r	r	0	0	r	0	r	0	0	0	0	0	r	0	0	0	r	0	r	0
ORSE	r	r	r	+	0	0	r	+	r	0	0	0	+	r	+	r	r	r	r	0	0	0	+	+	+	+	r	r	+	r
PYCH	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
COCA	0	0	r	+	0	0	0	0	0	r	0	0	0	r	+	0	0	0	+	+	+	+	r	0	0	0	0	0	0	0
ACMI	0	0	r	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	0	r	0	0	0	0	r	r	r	r	0	r	0	r	r	r	r	0	0	0	r	r	r	0	0	r	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	r	0	0	0	r	0	0	0	0	0	0	r	0
ARCO	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	r	r	r	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r	r	0	r	0	0	0	0	0	0	0	0
ASCO	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	+	r	r	r	r	r	0	r	r	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP	r	0	0	0	r	0	0	r	r	r	r	r	0	r	0	0	0	r	0	0	0	0	0	r	0	r	0	r	r	0
CAMI	0	0	0	r	0	0	0	0	r	r	0	0	0	0	0	0	r	0	r	r	0	0	0	r	0	r	0	0	0	0
MELI	+	r	+	0	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	0	r	r	r	r	r	r	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0
GEAM	r	0	0	0	0	0	r	0	0	0	r	r	r	r	0	0	0	r	r	0	r	r	0	0	0	0	r	r	r	0
TRRE	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
GOOB	0	+	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	r	r	r	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	r	r	r	r	+	+	r	r	r	+	r	r	r	0	r	r	r	r	r	r	r	r	r	1	r	+	+
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
DIPO	r	0	+	+	r	r	+	+	r	r	+	r	0	+	+	r	r	r	r	r	r	0	r	0	r	r	r	r	r	r
HYSP	0	0	0	0	0	+	r	r	0	0	0	0	0	0	r	0	0	0	0	r	0	0	r	0	r	0	0	r	0	+
PLSC	r	+	+	1	2	+	2	+	1	+	3	+	+	1	3	+	3	4	4	5	5	4	3	4	3	1	1	+	r	1
POJU	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r
PTCR	0	+	+	r	r	+	+	r	r	r	+	r	r	+	+	r	r	r	r	r	r	+	r	r	r	r	r	r	0	+
CLADON.	r	r	r	r	+	r	r	+	+	+	r	+	r	+	+	+	r	+	r	r	r	r	r	r	+	r	r	+	r	r
PELT.	1	1	+	r	+	1	+	r	r	+	1	+	+	+	+	r	+	1	+	+	r	1	+	+	r	r	+	r	r	r
STEREO.	r	r	r	r	r	r	r	r	+	r	r	r	r	r	0	r	r	r	0	0	0	r	0	r	r	0	r	0	r	+

Table B-3. continued (Sunwapta understorey 1967)

Species	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
SHCA	+	+	1	1	2	2	1	2	3	+	1	1	4	2	+	2	+	+	+	r	+	1	+	+	+	1	1	4	2	2
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	1	+	0	r	r	r	2	+	+	+	+	1	+	+	r	r	+	+	0	+	1	1	1	+	+	2	+	+	0
ROAC	r	r	r	r	r	r	0	r	r	r	r	r	r	r	+	r	+	r	r	+	r	r	r	r	r	r	r	0	r	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	r	0	1	+	r	0	+	+	+	+	0	+	+	r	r	+	+	+	+	+	+	r	+	+	r	+	r	r	r	r
LIBO	+	+	r	+	+	+	+	r	+	1	+	+	r	+	+	+	+	+	+	+	1	+	+	+	+	+	+	+	3	4
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	r	r	r	+	r	r	r	+	r	+	+	r	r	r	r	r	r	+	r	r	r	r	+	r	+	r	1	+	r	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	r	0	0	0	0	0	r	0	0	0	r	r	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
VAVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	+	r	r	0	0	r	r	r	r	r	r	r	r	r	r	0	r	0	r	r	0	r	r	r	r	+	r	r	+	+
CHUM	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	r	0	0
ORSE	0	r	0	r	0	0	r	r	r	0	+	r	r	0	0	0	0	0	0	r	0	0	0	r	r	r	r	+	r	r
PYCH	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	0	r	r	r	0	r	r	r	r	r	r	r	r
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	+	r	+
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	r	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	r	0	0	r	r	r	r	r	r	0	0	0
ANRO	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	r	r	0	0	r	0	0	0
ARCO	0	[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
ASCO	0	0	0	0	r	0	0	r	0	r	0	0	r	0	0	0	+	0	0	0	0	0	0	0	0	+	r	r	r	r
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0
SOSP	0	r	r	0	0	0	r	0	0	r	r	0	0	0	0	r	0	0	r	0	r	r	0	0	r	r	0	r	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	r	r	r	+	r	r	r	r	+	+	+	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r
GEAM	0	r	0	0	0	0	r	0	0	r	r	r	r	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	r	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
COTR	0	r	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
GOOB	r	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	+	r	r	+	r	r	r	r	r	r	r	r	r	r	+	+	+	+	+	r	+	+	r	r	r	r	r
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	+	r	r	r	r	r	r	r	0	+	+	+	0	r	r	0	0	r	r	+	r	r	r	r	r	r	r	r	r
HYSP	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
PLSC	3	1	+	r	r	+	0	+	r	0	r	1	+	+	r	+	r	r	+	r	+	+	+	+	+	+	3	+	4	1
POJU	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0
PTCR	r	r	r	+	r	r	r	r	+	r	+	r	+	r	0	r	0	0	r	r	+	r	0	0	r	0	r	0	r	0
CLADON.	+	+	+	+	r	r	r	+	+	+	+	+	r	r	r	r	+	+	+	r	r	r	r	r	r	+	+	r	r	r
PELT.	+	r	+	+	+	r	+	+	r	1	+	r	+	+	+	+	+	+	+	+	r	+	r	+	+	+	r	+	+	r
STEREO.	r	r	r	r	r	r	r	r	r	0	r	r	0	r	r	r	r	r	r	r	0	0	0	r	r	r	0	r	r	0

Table B-3. continued (Sunwapta understorey 1967)

Species	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
SHCA	1	3	3	3	2	4	+	1	1	2	2	+	+	1	+	1	1	2	+	1	1	1	2	2	1	+	2	1	r	r
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	0	+	1	+	+	r	r	+	+	r	r	+	r	+	1	+	+	1	+	+	1	r	r	r	r	r	r	+	1
ROAC	0	r	r	r	r	r	r	r	r	r	+	r	r	+	r	r	r	0	r	r	r	r	+	0	r	r	+	r	r	r
SALIX	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	+	+	+	+	+	+	r	r	r	+	r	+	+	0	r	r	r	+	r	0	+	r	r	r	r	r	r	r	+
LIBO	+	+	+	+	+	1	r	+	+	+	+	+	+	+	+	+	+	+	+	1	r	r	+	+	+	+	+	r	+	+
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
VACA	r	r	r	r	0	r	+	+	+	+	+	+	r	r	r	r	+	r	+	+	+	+	r	+	+	r	+	r	+	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	r	0	r	r	0	0	0	0	r	0	r	0
VAVI	0	+	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	+	r	r	r	r	+	r	0	r	r	r	0	0	r	0	r	r	r	r	r	r	0	r	r	0	0	r	r	r
CHUM	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	r	0	+	r	+	r	r	r	0	0	0	r	r	r	0	r	0	r	+	r	r	+	0	+	0	r	0	r	r
PYCH	0	r	0	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r
COCA	+	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	r	0	r	r	0	r	r	r	r	r	r	0	0	0	0	0	0	0	r	r	0	0	0	0	r	0	0	0	r
ANRO	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r
ARCO	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0
ASCI	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
SEST	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	r	0	0	r	r	r	0	0	0	0	0	r	0
SOSP	0	0	r	0	0	r	r	r	0	0	r	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0
CAMI	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	r	r	r	r	r	+	r	r	r	+	r	r	r	r	r	+	+	r	r	r	r	+	r	r	r	r	r	r	r	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	r	r	r	0	0	0	r	r	r	0	r	r	0	0	0	0	0	r	r	r	r	0	0	0	r	r	0	0	r	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	r	0	0	0
HAOB	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HA[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	r	r	r	+	r	r	r	r	r	+	r	+	r	r	r	r	r	r	r	r	+	1	1	1	+	+	+
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0
CA[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	r	r	r	r	+	+	r	r	+	+	r	r	0	r	+	+	r	r	r	0	0	0	r	0	r	r	r
HYSP	0	0	0	0	0	r	0	0	r	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	+	+	+	r	r	+	1	2	+	+	+	+	r	r	r	0	1	2	1	r	0	+	+	r	1	1	+	+	r	1
POJU	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
PTCR	0	0	0	0	0	r	r	+	+	r	r	+	r	+	0	r	+	+	+	r	0	r	r	0	0	r	0	r	+	r
CLADON.	r	r	r	r	+	+	+	+	+	+	+	+	r	r	+	r	+	1	+	+	r	+	r	+	+	+	r	+	+	+
PELT.	+	r	1	1	1	+	+	+	r	+	+	+	r	+	+	+	+	+	1	+	r	+	+	+	+	+	+	+	+	r
STEREO.	0	r	r	r	r	r	r	0	r	r	r	0	r	r	r	r	r	+	r	0	r	r	0	r	r	r	r	0	0	r

Table B-3. continued (Sunwapta understorey 1967)

Species	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SHCA	1	+	3	1	4	1	1	3	1	2	2	2	3	2	2	3	3	+	3	4	3	3	1	1	2	1	1	+	2	3
LEGR	0	0	0	0	0	0	0	0	0	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	+	0	0	r	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	1	+	+	1	+	+	1	+	+	r	r	r	r	1	r	r	r	+	1	+	+	+	+	r	0	r	r	+	r
ROAC	r	r	+	0	r	r	r	+	0	0	0	r	r	r	r	r	0	r	r	r	+	r	r	r	+	0	r	+	r	r
SALIX	0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	1	r	+	r	+	+	+	r	+	+	r	r	r	r	+	1	+	+	+	1	+	r	r	r	0	+	+	r	r	+
LIBO	r	+	+	+	+	+	+	+	+	+	+	+	+	1	+	+	+	+	+	+	+	+	+	+	r	r	r	+	+	r
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	+	+	+	+	+	r	r	r	r	r	r	r	r	+	+	+	+	r	+	r	+	+	+	+	r	r	+	+	r	r
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	0	0	0	0	0	r
VAVI	0	0	0	0	0	0	r	+	+	+	r	+	+	r	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	r	r	r	r	r	r	r	+	+	+	r	+	+	r	+	+	r	r	r	r	r	r	r	r	r	r	r	r
CHUM	0	r	0	0	0	0	0	0	0	r	0	0	r	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	+	r	+	r	+	r	r	+	r	r	r	0	0	r	+	r	r	0	+	+	r	r	r	r	r	+	0	0	0	0
PYCH	+	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0
COCA	0	0	0	0	0	r	0	0	r	r	r	r	r	0	+	+	+	0	0	0	0	0	0	0	0	0	0	0	r	0
ACMI	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	r	r	r	r	r	r	0	r	0	r	r	r	0	r	0	r	r	0	0	0	0	0	r	0	0	r	r	r	r
ANRO	0	r	0	r	0	r	r	r	r	r	r	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r
ARCO	0	0	0	0	0	0	r	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
ASCI	0	0	r	0	0	0	0	r	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	0	0	0	r	r	r	r	r	r	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r
SOSP	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	+	r	r	r	r	r	r	+	r	+	r	r	r	r	r	r	r	r	+	r	r	r	r	r	+	r	r	r	r	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	r	r	0	0	r	r	r	r	r	r	r	0	r	r	0	r	r	0	0	0	r	r	r	0	0	0	r	0	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	r	+	r	r	r	r	r	+	r	1	r	r	r	r	r	r	r	+	+	r	r	+	r	1	1	+	r	r	r
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	r
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	r	r	r	r	0	0	r	r	0	r	+	r	0	0	0	0	r	r	r	0	r	r	r	0	r	r	r	r
HYSP	0	0	+	r	0	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0
PLSC	+	2	1	+	r	r	r	1	2	2	0	2	+	1	+	+	r	r	4	r	+	2	2	+	1	+	+	+	1	r
POJU	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
PTCR	r	+	r	0	r	0	r	r	r	r	0	r	+	0	0	r	0	r	r	+	r	+	r	r	r	0	r	0	r	r
CLADON.	r	+	+	+	r	r	r	r	r	r	+	+	+	r	+	r	r	r	r	r	r	r	+	+	+	+	+	+	+	+
PELT.	1	+	+	r	r	+	+	+	+	1	+	+	+	r	+	+	+	r	r	+	r	r	+	+	+	r	+	+	r	r
STEREO.	0	r	r	r	0	0	0	r	r	r	r	r	r	0	r	r	r	0	r	+	r	r	r	r	0	0	0	r	r	r

Table B-3. continued (Sunwapta understorey 1967)

Species	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
SHCA	2	1	+	1	+	2	1	3	3	2	1	3	1	2	+	+	2	4	4	2	3	3	1	+	+	+	2	3	2	1
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	+	0	0	0	0	0	0
MEPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	0	r	r	r	r	r	r	r	r	r	r	1	r	r	r	r	r	+	1	3	+	+	r	r	1	r	+	+	+
ROAC	+	+	r	r	r	+	+	+	+	+	r	r	r	0	r	r	r	r	r	0	r	r	+	r	0	r	0	r	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	r	r	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	r	+	+	+	+	+	r	+	+	+	+	r	r	r	+	+	1	+	r	r	+	r	r	r	r	r	r	+	+
LIBO	1	+	+	+	r	+	+	+	+	+	+	+	r	+	+	r	r	1	+	+	r	+	r	r	r	r	r	r	+	+
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
VACA	+	r	+	r	r	+	+	+	+	+	+	+	+	+	+	r	r	r	+	r	+	+	r	r	r	+	+	r	+	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAVI	0	0	0	0	0	0	0	r	+	+	+	r	0	0	r	r	r	+	+	r	0	+	+	0	+	+	0	0	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	+	r	r	r	r	r	r	r	r	r	r	r	+	+	+	+	r	r	r	r	r	r	+	+	+	+	r	r	r	r
CHUM	0	0	0	0	0	0	r	r	0	0	0	r	0	0	0	0	r	r	r	r	0	0	r	0	r	r	0	r	r	0
ORSE	+	r	r	0	0	r	+	+	r	+	+	+	r	r	0	0	+	r	+	r	0	r	0	r	r	r	0	r	r	r
PYCH	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r
COCA	r	0	0	0	0	r	0	0	0	0	0	0	+	r	+	+	0	0	r	+	r	+	0	0	0	0	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	r	0	0	0	0	0	0	0	r	r	r	r	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
ANHO	r	r	0	r	r	0	r	0	0	r	r	r	r	r	r	r	r	r	0	r	r	0	r	+	r	r	r	r	r	0
ANRO	r	0	r	0	0	0	0	0	0	0	0	0	r	r	r	0	r	0	0	r	r	0	r	r	r	0	r	r	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	+	r	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0
ASCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	+	r	+	r	0	0	0	0	+	+	0
HICY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	+	0	0	0	0	0	0	0	0	0	r	0	0	0
SOSP	r	r	0	r	0	0	0	0	0	r	0	r	r	r	r	r	r	r	r	r	0	r	r	0	r	r	r	r	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
MELI	+	+	+	+	+	+	r	+	+	+	r	+	r	r	+	r	r	r	r	+	+	+	r	r	r	r	+	r	r	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	r	r	0	0	r	0	r	r	r	r	r	r	r	0	r	0	r	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	+	+	+	1	2	+	+	+	+	r	+	r	+	+	+	+	r	r	+	r	r	r	+	r	r	r	+	+	r
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
DIPO	r	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r	0	0	0	r	0	0	0	r	r	r	r	r	r	r
HYSP	0	+	0	0	0	r	0	r	0	0	0	r	0	r	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	r
PLSC	+	+	+	+	r	r	1	+	+	r	+	1	1	+	r	r	r	+	+	+	+	r	r	+	2	4	2	2	5	+
POJU	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
PTCR	r	0	r	r	r	r	+	r	+	r	+	+	+	+	r	0	r	r	0	r	r	r	0	+	r	+	+	r	+	r
CLADON.	+	+	+	+	+	r	r	+	r	r	+	r	r	+	+	r	r	r	r	+	r	r	r	r	+	r	r	+	r	+
PELT.	r	r	+	+	+	+	+	+	1	r	r	r	+	r	r	r	+	+	1	+	+	r	+	+	+	r	r	+	r	+
STEREO.	r	r	0	r	r	0	r	r	r	r	+	r	r	0	r	r	0	r	r	r	r	0	r	r	r	r	0	0	0	+

Table B-3. continued (Sunwapta understorey 1967)

Species	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
SHCA	+	2	2	3	1	1	1	1	+	+	2	1	+	r	1	1	2	1	2	1	3	1	2	3	3	+	1	+	2	2
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
MEPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	+
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	+	+	r	1	+	0	0	r	+	+	+	+	+	r	1	+	r	+	r	r	+	+	r	+	+	r	1	1	r
ROAC	0	r	+	+	r	r	0	r	r	r	+	+	r	r	r	r	r	r	r	0	r	r	r	0	0	r	+	r	r	r
SALIX	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	r	0	r
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	r	r	r	r	r	r	+	+	+	+	+	r	r	r	r	r	r	r	r	r	+	+	+	+	1	+	r	+	+
LIBO	0	r	r	r	r	r	r	+	+	+	+	+	r	r	r	r	r	r	r	r	r	+	+	+	+	1	+	r	+	+
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	r	+	r	+	r	+	+	r	+	r	r	+	r	r	r	+	+	r	r	+	+	+	+	+	1	+	+	+	+	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0
VAVI	0	r	+	r	r	+	0	0	0	0	0	0	0	0	r	r	0	0	0	r	r	r	r	0	0	r	0	0	0	0
JUNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	+	r	+	+	+	+	+	r	r
CHUM	0	0	+	0	0	r	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
ORSE	0	r	0	r	r	r	r	0	0	0	0	0	0	0	r	0	0	r	r	r	+	+	r	0	r	r	r	0	0	r
PYCH	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	r
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMO	0	0	0	r	r	0	r	r	+	r	r	+	r	r	r	r	0	r	0	r	0	r	0	r	r	r	r	r	r	r
ANRO	0	0	0	0	0	0	0	r	0	0	0	r	r	r	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0
ARCO	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	+	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r
ASCO	0	0	0	0	0	0	r	0	0	r	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r	r
NICY	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0
SOSP	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	r	0	0	0	0	0	r	r	r	0	0	r	r	r	0
CAMI	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	r	r	r	r	r	r	r	+	r	r	r	r	+	+	r	r	r	+	r	r	r	r	r	+	+	r	r	r	+	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	r	0	0	0	0	0	r	r	r	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	+	+	+	+	+	+	r	r	r	+	r	+	1	+	+	+	+	+	+	+	+	r	r	r	r	+	r	r	+
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	0	r	0	r	r	r	0	0	0	r	0	r	r	0	r	r	0	r	r	+	r	0	r	0	0	r	0	r
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
PLSC	+	+	r	r	0	+	1	r	+	0	r	r	r	r	r	+	+	r	r	+	1	1	2	+	1	+	+	0	0	+
POJU	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
PTCR	r	r	0	0	0	r	r	0	0	0	0	0	0	0	0	0	+	0	r	r	r	+	+	1	r	r	r	0	0	r
CLADON.	+	+	r	+	+	+	r	+	r	+	r	+	+	+	+	r	+	r	+	+	+	+	r	r	r	+	r	r	r	r
PELT.	+	r	r	+	+	r	r	+	r	r	r	r	+	r	+	+	1	+	+	1	+	+	+	+	1	+	+	r	+	+
STEREO.	r	r	0	r	r	r	r	r	r	0	r	r	r	0	r	r	0	r	r	r	r	r	r	r	0	0	0	r	r	r

Table B-3. continued (Sunwapta understorey 1967)

Species	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
SHCA	2	3	1	1	1	2	4	4	1	3	1	3	2	2	+	+	+	1	+	r	2	2	2	r	+	1	1	1	3	2
LEGR	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	r	0	r	r	r	r	r	+	r	+	+	+	+	r	1	2	0	+	+	r	+	+	2	1	+	1	1	r	1
ROAC	r	r	r	r	r	0	0	0	0	r	r	r	+	r	+	+	r	r	+	r	+	+	r	r	+	r	+	+	r	0
SALIX	r	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	2	+	r	+	+	1	r	+	+	+	+	r	r	+	+	+	1	+	2	r	r	+	+	+	+	+	+	1	r
LIBO	+	2	+	r	+	+	1	r	+	+	+	+	r	r	+	+	+	1	+	2	r	r	+	+	+	+	+	+	1	r
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	+	r	+	+	+	+	+	r	+	+	r	+	+	+	+	r	0	0	r	r	r	0	r	r	r	r	+	r	r	+
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	r	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAVI	r	0	0	0	0	0	0	r	r	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	+	r	+	+	+	r	r	r	r	r	r	+	r	r	0	r	r	r	r	r	r	r	0	r	r	r	+	r
CHUM	0	+	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	r	r	0	r	r	0	r	r	r	+	0	0	r	r	r	0	r	0	0	r	0	0	0	0	0	0	0	r	0
PYCH	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	0	0	r	0	r	r	0	r	r
COCA	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	r	0	0	0	0	0
ACMI	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	0	0	r	0	0
AGOS.	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	r	r	r	r	r	0	0	0	0
ANHO	r	0	r	+	+	+	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r	r	0	0	r	0	r
ANRO	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	0	0	0	0	0
ARCO	0	r	0	0	0	0	0	0	0	0	r	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0
ASCO	r	+	0	0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0
HICY	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	r	0	0	r	r	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0
SOSP	0	0	r	r	r	0	r	0	0	r	0	0	0	0	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
MELI	+	+	+	r	r	+	+	+	r	r	r	r	r	+	+	r	r	r	r	+	r	r	+	r	r	r	+	r	+	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	r	r	r	0	0	0	r	0	r	0	0	0	r	r	r	0	0	0	0	r	r	0	0	0	r	0	r	0	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	r	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	r	0	0	0	0	r	+	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	+	+	+	r	r	r	+	+	+	+	+	+	+	+	r	r	+	r	+	r	r	r	r	r	+	r	+	+	+
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0	0	r	r	0	0	0	0	0	0
CAREX	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	r	r	+	+	r	r	r	r	r	r	0	r	+	0	0	r	r	0	0	r	0	r	0	0	0	0	0	0
HYSP	r	0	0	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	+	+	+	1	2	1	r	r	1	r	0	r	r	r	r	r	0	r	r	0	r	+	r	+	0	0	0	0	0	+
POJU	0	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	0	0	r
PTCR	r	0	r	+	r	r	r	r	+	r	0	r	r	0	0	0	0	0	0	0	+	r	r	0	0	0	r	0	0	+
CLADON.	r	r	+	r	+	r	r	r	+	r	+	+	+	+	+	+	r	r	+	r	r	r	r	r	+	+	r	+	+	+
PELT.	+	+	+	r	1	+	+	+	1	+	+	r	+	+	+	r	r	r	+	+	r	r	r	r	+	r	r	r	+	+
STEREO.	r	0	r	0	0	r	r	0	r	+	r	r	r	r	0	0	0	r	r	r	0	r	0	r	0	0	0	0	0	r

Table B-3. continued (Sunwapta understorey 1967)

Species	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
SHCA	2	3	3	2	3	2	2	1	3	2	3	4	3	3	3	4	2	1	3	2	1	1	2	1	1	1	1	2	3	2
LEGR	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	0
JUCO	+	+	0	r	r	+	r	+	r	r	0	0	0	+	+	+	+	r	+	1	r	+	+	+	r	r	r	1	+	+
ROAC	r	0	0	0	1	0	0	r	r	r	r	0	0	r	0	0	0	0	0	0	0	r	+	+	+	+	+	+	+	+
SALIX	0	0	0	0	0	r	0	0	0	r	r	0	0	r	0	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	+	r	+	r	r	r	+	+	+	+	r	r	r	+	r	r	r	r	+	+	+	0	0	r	r	r	r	r	+
LIBO	+	+	r	+	r	r	r	+	+	+	+	r	r	r	+	r	r	r	r	+	+	+	0	0	r	r	r	r	r	+
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	r	r	r	+	r	1	1	1	1	+	+	+	+	+	r	r	r	r	+	r	r	r	r	r	r	r	r	+	0	0
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	r	0	r	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	+	+	0	0	0	0	0
VAVI	0	r	r	0	0	r	+	r	0	0	0	0	0	+	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	r	r	+	+	+	+	+	r	+	0	+	r	r	r	r	r	r	+	r	r	r	r	r	r	r	+	+	r
CHUM	0	0	0	0	0	+	+	r	r	r	0	0	0	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	0	r	0	+	+	+	r	+	+	r	r	0	r	+	+	r	r	r	r	r	r	0	0	0	0	0	0	r	r
PYCH	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r
COCA	0	0	0	0	0	0	r	r	0	r	r	+	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	r
ACMI	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r	r	r	r	r
AGOS.	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0
ANHO	r	0	r	+	+	+	r	r	0	0	r	0	0	r	+	+	+	+	r	r	r	r	r	r	r	r	r	0	r	r
ANRO	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	r	r	0	0	0	0	r	0	0	r	r	0	r	r
ARCO	0	0	0	0	0	0	0	0	+	+	0	0	0	0	0	0	0	0	0	r	0	r	0	r	0	0	0	0	0	0
ASCI	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	r	0	0	0	r	0	0	0
ASCO	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	r	0	0
HICY	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	r	r	r	r	0
SOSP	r	0	0	0	0	0	0	r	r	r	0	0	r	r	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	r
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	r	+	+	+	+	+	+	+	+	+	r	r	r	r	r	r	r	+	+	+	+	r	r	r	r	r	r	+	+	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	r	0	r	0	r	0	r	r	0	r	0	r	r	0	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	r	0	0	0	r	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	r	r	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	+	+	r	r	r	r	r	+	+	+	+	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	+	+	+
FESC	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	r	0	r
CAREX	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	r	r	r	0	r	0	0	+	0	0	r	r	0	0	+	r	r	0	r	0	0	r	r	0	r
HYSP	0	0	0	0	r	0	0	r	r	+	r	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0
PLSC	0	0	r	r	2	4	1	+	r	+	r	0	1	1	r	r	+	+	+	+	r	+	+	+	0	0	r	r	r	+
POJU	0	0	0	r	0	0	r	r	r	r	0	0	0	0	0	0	r	r	r	0	r	r	r	0	r	r	r	r	0	r
PTCR	0	0	0	0	+	+	+	r	0	r	0	0	0	0	r	0	r	0	0	r	0	0	0	r	0	0	0	r	r	0
CLADON.	+	r	r	r	r	r	r	+	+	+	r	r	+	+	r	r	+	+	+	+	+	+	+	r	r	r	+	+	r	r
PELT.	+	1	+	1	1	1	+	+	+	+	r	1	+	r	+	1	+	+	+	+	r	+	+	+	r	r	+	+	r	r
STEREO.	r	r	0	0	r	0	0	r	r	0	0	0	r	r	r	0	0	r	r	r	0	r	r	r	0	0	0	r	r	+

Table B-3. continued (Sunwapta understorey 1967)

Species	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
SHCA	2	1	2	1	+	1	2	+	1	2	2	1	3	1	3	3	1	4	3	2	2	1	1	1	1	1	1	1	2	2
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
MEPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	r	1	1	+	r	r	+	0	0	+	r	1	1	+	0	r	0	0	0	+	+	+	r	r	r	r	1	+	r
ROAC	+	r	+	+	r	r	+	r	0	0	0	r	+	0	0	0	0	0	0	r	+	0	0	r	r	r	0	r	r	0
SALIX	0	0	0	0	0	0	r	0	0	r	0	r	r	r	0	0	0	r	0	0	r	r	r	0	r	r	r	r	r	r
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
ARUV	+	r	r	+	r	r	r	0	r	r	r	r	r	0	+	r	r	+	+	r	r	+	r	r	r	r	+	0	+	r
LIBO	+	r	r	+	r	r	r	0	r	r	r	r	r	0	+	r	r	+	+	r	r	+	r	r	r	r	+	0	+	r
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
VACA	0	0	0	0	0	+	r	r	+	r	+	+	+	r	r	r	+	+	+	+	+	+	+	+	+	+	+	+	+	r
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0
VAVI	0	0	0	0	0	0	0	0	0	0	0	+	+	r	0	0	0	0	0	0	0	0	0	0	r	1	+	+	+	0
JUNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0
FRVI	r	r	r	r	r	r	r	+	r	r	+	+	+	+	r	+	+	r	r	+	r	+	r	+	+	r	+	r	+	+
CHUM	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	r	r	+	r	r	0	0	0
ORSE	r	0	r	r	0	0	+	r	r	r	r	+	r	r	r	r	0	0	0	r	0	r	r	r	r	+	+	r	0	0
PYCH	r	r	r	r	r	0	0	r	r	r	0	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r	r
COCA	+	+	r	+	0	0	0	0	0	r	0	0	0	0	0	r	0	r	r	0	0	0	0	0	r	r	r	+	0	0
ACMI	r	r	r	r	r	r	0	0	0	r	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
AGOS.	0	0	r	r	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	r	r
ANHO	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
ANRO	r	r	r	r	r	r	0	0	0	0	r	0	0	r	r	r	0	0	r	r	r	r	r	r	r	r	r	0	0	r
ARCO	0	0	0	1	r	0	0	0	r	r	r	r	0	0	0	0	0	0	0	+	0	0	0	0	0	r	0	0	0	0
ASCI	0	0	0	0	r	0	0	0	r	0	r	0	0	0	0	0	r	0	0	+	r	0	r	r	r	0	0	r	0	r
ASCO	+	r	r	0	r	r	r	r	0	0	0	0	0	r	r	r	0	0	r	0	0	r	0	0	0	r	0	0	r	0
HICY	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	r	r	r	r	r	r	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
SOSP	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	0	r	0	r	r	r	0	0	r	r	r	r	0	r	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r
MELI	r	r	r	r	r	r	r	r	r	+	+	+	+	+	r	r	+	+	+	+	+	+	+	+	r	+	+	+	r	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	r	r	r	r	r	r	r	r	0	r	r	r	r	0	0	r	0	r	r	r	r	0	0	r	0	0	0	0	r	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	r	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	r	r	0	0	0	0	0	r	r	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	r	+	r	r	+	+	r	r	r	+	+	r	+	+	+	+	+	+	+	+	+	+	r	r	r	r	r	r	r
FESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRSP	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	+	r	r	r	r	0	0	0	r	+	+	r	0	r	r	r	r	0	0	r	r	r	r	r	r	r	0	r	r	r
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
PLSC	+	+	r	r	0	0	0	r	r	+	1	1	1	+	+	0	r	r	r	+	1	2	+	+	2	3	2	1	+	+
POJU	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	0	0	r
PTCR	0	0	0	0	0	0	0	0	0	r	r	0	r	r	r	0	0	0	0	+	r	0	0	0	0	r	+	+	+	0
CLADON.	r	r	r	+	+	r	+	+	+	+	+	+	r	+	r	r	+	+	+	+	+	+	+	+	r	+	+	r	+	+
PELT.	r	r	r	r	r	+	+	+	+	+	+	+	+	+	r	1	+	r	+	r	+	+	+	+	+	+	+	+	+	+
STEREO.	0	r	r	0	0	r	r	0	0	0	r	r	r	r	r	0	r	0	r	r	r	0	r	0	0	0	r	0	0	0

Table B-3. continued (Sunwapta understorey 1967)

Species	391	392	393	394	395	396	397	398	399	400
SHCA	3	1	+	1	2	+	+	1	2	2
LEGR	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0
JUCO	2	r	+	0	1	r	r	r	+	0
ROAC	r	r	r	r	r	r	+	r	+	r
SALIX	0	r	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0
ARUV	0	r	+	r	r	r	r	0	r	+
LIBO	0	r	+	r	r	r	r	0	r	+
PHYL	0	0	0	0	0	0	0	0	0	0
VACA	+	+	r	r	r	r	r	0	r	0
VAMY	0	0	0	0	0	0	0	0	0	0
VASC	0	0	r	0	0	r	r	r	0	1
VAVI	0	0	0	0	0	0	0	0	0	0
JUHO	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	r	r	+	r	r	r	r	r
CHUM	0	r	0	0	0	0	0	0	0	r
ORSE	r	r	r	r	0	0	r	0	0	r
PYCH	r	r	r	r	r	r	0	0	r	r
COCA	r	0	r	0	r	0	r	r	r	r
ACMI	r	r	r	0	0	r	r	r	r	0
AGOS.	r	0	0	0	0	0	r	r	0	0
ANHO	r	r	r	r	r	r	r	r	r	r
ANRO	r	0	r	r	r	r	r	r	r	r
ARCO	r	r	0	0	r	0	r	0	0	r
ASCI	r	0	r	0	r	0	0	r	0	0
ASCO	0	r	0	0	r	0	r	r	r	r
HICY	0	0	0	0	r	0	0	0	0	0
SEST	0	0	r	r	r	r	r	r	0	0
SOSP	r	r	r	0	r	r	r	r	r	0
CAMI	r	r	0	0	0	0	0	0	0	0
MELI	1	+	r	r	r	r	r	r	r	r
GELI	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0
GEAM	r	r	r	r	r	r	r	r	r	r
TRRE	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	r
HAOB	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	+	r	r	r	r	r	r	r
FESC	0	0	0	0	0	0	0	0	0	0
TRSP	0	0	0	0	0	r	0	r	r	0
CAREX	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	r	r	r	r	r
HYSP	0	0	0	0	0	0	0	0	0	0
PLSC	r	r	r	r	r	r	r	r	1	+
POJU	0	0	r	r	r	r	r	r	r	r
PTCR	r	0	0	0	r	0	0	0	1	+
CLADON.	+	+	r	r	r	r	r	+	r	r
PELT.	r	r	+	r	r	r	+	r	r	r
STEREO.	r	r	r	0	r	r	0	r	r	+

Table B-4. Understorey species cover estimates for Sunwapta 1989

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SNCA	6	7	12	+	10	6	12	8	6	9	9	8	4	7	9	9	17	6	4	10	9	11	14	15	5	4	5	8	4	3
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	0	r	0	+	0	0	0	0	0	r	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	4	6	r	0	2	r	0	2	3	r	4	12	0	0	3	+	3	3	2	2	+	2	+	2	9	4	7	4	3
ROAC	2	+	2	2	2	+	+	2	2	+	+	2	+	+	+	+	r	r	+	+	r	0	r	r	+	+	+	+	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	4	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
ARUV	+	0	0	+	3	2	4	+	2	3	3	3	+	4	3	2	2	3	2	+	2	+	0	+	3	+	2	3	+	+
LIBO	5	6	4	r	0	5	4	4	4	3	5	3	2	4	5	4	3	4	3	3	2	4	5	3	5	6	5	5	6	6
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0
VACA	4	+	+	+	+	+	+	r	+	+	0	r	r	r	+	+	+	+	+	+	3	3	2	+	2	3	2	3	r	r
VAMY	r	r	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0
VAVI	0	0	0	0	0	0	0	0	0	+	r	+	0	0	0	+	2	2	2	3	+	2	2	+	0	0	0	0	r	r
JUNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
FRVI	+	0	+	2	+	r	r	3	+	r	7	+	3	3	3	2	3	2	3	3	+	3	3	r	2	+	3	+	+	5
CHUM	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	r	r	r	+	+	0	0	r	0	0	0	r	+	0
ORSE	+	+	+	0	0	+	2	2	r	+	+	0	0	r	r	0	r	0	r	r	r	r	r	r	r	+	+	r	r	r
PYCH	r	r	r	0	r	0	r	r	0	r	r	0	0	r	r	0	r	r	0	r	0	r	0	r	r	r	0	r	r	r
COCA	r	r	0	0	0	2	r	0	2	0	0	0	0	4	0	0	2	2	3	3	3	3	2	4	r	0	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	0	0	0	0	0	0	r	0	r	r	r	r	0	0	0	r	+	r	0	0	0	0	0	r	r	0	r	+
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
ARCO	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	+	r	+	0	r	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0	r	0	r
ASCO	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	r	r	+	r	2	2	2	+	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	r	r	0	0	0	r	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	r	r	r	r	r	r	0	r	r	r	r	r	0	0
MELI	2	2	2	+	+	+	+	+	+	r	+	+	r	r	r	r	0	r	r	r	+	0	0	0	r	+	2	+	+	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	+	+	+	r	0	0	0	0	0	0
GEAM	0	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	r	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	5	4	5	5	5	4	5	5	5	4	5	4	4	5	5	4	4	5	5	5	4	5	5	4	5	4	4	4	4
LYCO	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
DIPO	5	r	2	+	r	3	r	r	0	0	r	+	+	+	r	r	r	r	r	r	r	0	r	0	0	0	r	+	+	0
DIUN	r	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	+	r	0	r	5	r	0	+	0	0	0	0	0
PLSC	29	42	18	2	+	4	6	16	3	4	5	8	23	3	9	34	9	22	22	21	32	23	40	42	29	52	38	41	31	16
POJU	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	r	0	0	0	0	0	0	0
CLADINA	+	+	+	+	r	r	0	r	0	0	r	2	r	r	r	r	0	r	+	r	0	0	0	0	r	+	r	r	2	+
CLADON.	0	0	0	0	0	r	r	r	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	r	r	0	r	r
PELT.	2	+	+	r	r	3	+	+	+	+	2	2	2	2	2	r	+	r	2	r	+	r	r	r	+	2	+	3	2	+
STEREO.	r	0	0	r	r	r	0	0	r	r	r	0	r	r	0	0	0	0	r	r	0	0	0	0	0	r	r	0	r	r

Table B-4. continued (Sunwapta understorey 1989)

Species	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
SHCA	8	4	2	3	7	6	3	8	10	6	6	6	22	5	17	4	15	6	4	7	+	6	8	9	5	7	11	16	18	13
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	2	r	45	4	0	r	3	6	6	4	4	7	6	6	4	10	r	3	+	6	r	0	4	6	+	2	+	r	r
ROAC	r	+	+	r	+	+	r	+	2	2	+	+	+	+	+	+	+	+	r	+	+	r	+	+	+	+	+	+	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	2	+	2	+	3	+	+	r	0	+	4	+	+	2	2	4	3	3	2	+	0	3	4	4	2	2	3	0	+	2
LIBO	3	5	4	3	8	6	3	10	4	3	3	4	4	4	5	8	3	5	4	6	5	6	+	5	3	5	6	5	3	4
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	2
VACA	r	+	+	+	2	+	4	r	r	+	+	+	3	3	+	r	+	2	+	2	2	2	r	2	3	3	2	2	2	2
VAMY	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
VAVI	+	0	0	2	3	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	2	3	3
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0
FRVI	4	3	+	r	r	+	6	r	r	r	+	r	r	+	r	r	r	r	2	2	+	+	r	+	2	+	2	+	2	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	r	0	0	0	0
ORSE	+	r	r	0	r	0	0	0	+	2	+	r	r	r	r	r	r	r	r	0	0	0	r	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	r	r	0	r	r	r	r	r	0	r	r	r	r	0	r	0	0	r	r	r	r	r	0
COCA	0	0	0	0	0	0	0	0	r	0	0	r	0	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	+	4
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	r	r	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r	r	+	0	0	0	r	0	r	0	0	0
ANRO	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	+	r
ASCI	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0
ASCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	+	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	r	0	0	r	0	r	+	r	r	0	0	0	0	r	0	0	0	r	r	r	r	0	r	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0
MELI	0	0.6	+	r	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	r	+	+	r	0	0	0	0
GELI	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	+	r
GEAM	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	r	0	0	0	0	r	0	r	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	r	0	r	0	0	0	0	0	0
HAOB	r	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	5	5	3	3	5	5	4	4	3	5	4	4	4	4	3	3	4	4	4	3	4	5	4	4	4	4	5	5	4
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	r	+	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	+	r	r	+	r	0	+	r	+	+	0	+	0	0	+	+	r	0	0	r	r	0	r	0	0	0	0	0	0
DIUN	0	0	0	0	0	+	2	+	+	0	r	r	r	r	0	r	0	r	+	r	r	r	0	0	0	0	0	0	0	0
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	+	2	0	0	0	0	0	0	r	0	0	2	r
PLSC	23	18	3	35	12	+	3	4	4	24	19	14	36	31	18	6	5	29	35	28	4	11	28	31	55	52	41	42	31	37
POJU	r	r	0	r	0	r	r	r	r	r	0	0	r	r	r	r	0	r	0	0	r	0	0	0	0	0	0	0	0	0
PTCR	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+
CLADINA	+	+	+	r	+	+	2	+	+	+	r	+	+	2	+	r	r	+	+	+	r	0	0	r	r	r	r	0	0	0
CLADON.	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	0	r	0	0	0	0	0
PELT.	+	+	r	2	3	+	2	2	r	+	3	2	0	0	3	2	+	r	+	r	r	r	r	+	r	3	r	+	+	2
STEREO.	r	r	0	r	0	+	r	r	0	r	r	r	0	r	r	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0

Table B-4. continued (Sunwapta understorey 1989)

Species	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
SNCA	6	8	14	19	8	8	7	4	15	6	7	5	11	8	10	10	7	20	9	10	13	8	3	19	8	11	10	5	5	7
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	2	+	3	4	+	3	5	r	2	5	6	8	6	3	0	5	5	11	4	+	6	+	3	88	3	2	2	3	6	5
ROAC	r	+	+	+	+	+	+	+	+	r	+	+	+	+	+	+	2	+	+	+	+	+	+	+	+	+	+	+	r	+
SALIX	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	2	0	2	2	3	4	5	4	+	3	3	3	3	3	+	2	+	2	2	2	2	r	+	r	3	5	5	2	5
LIBO	4	4	4	4	4	5	4	2	4	6	3	4	4	5	5	7	4	4	6	6	4	4	4	4	5	4	5	6	5	6
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	0	0	0
VACA	2	+	+	2	3	2	+	r	2	2	2	+	2	+	0	2	2	+	+	2	+	+	r	2	2	+	+	+	r	r
VAMY	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	+	r	0	r	0	0	0	0	0
VAVI	3	3	2	2	0	0	0	0	0	+	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUNO	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	4	2	+	2	3	4	2	2	2	r	+	+	r	0	r	2	+	+	3	3	0	r	+	r	+	+	+	2	3	+
CHUM	r	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	r	0	0	+	0	0
ORSE	0	0	0	r	r	r	0	0	0	r	0	r	0	r	r	+	0	r	+	+	+	+	0	2	+	r	r	0	r	+
PYCH	r	r	r	0	r	0	r	r	0	0	r	r	r	r	0	0	r	0	0	0	r	r	r	r	r	r	r	r	r	r
COCA	0	0	r	0	0	0	0	0	0	r	0	0	0	0	+	+	0	0	0	0	0	r	r	3	+	+	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	0	0	0	0	+	r	r	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
ARCO	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	r	r	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	+	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	0	0	0	0	r	r	0	r	0	0	0	r	0	0	0	0	r	0	0	0	0	r	0	0	0	r	r	0
CAMI	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	0	0	0
MELI	r	0	0	0	+	r	r	2	r	+	+	2	+	r	+	2	+	+	+	+	r	r	+	+	+	+	+	+	+	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	+	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	r	0	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	4	4	3	4	4	4	4	3	4	4	4	4	4	4	4	4	2	4	4	4	5	4	4	5	5	5	4	4	4
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	+	0	0	0
DIPO	0	0	0	0	r	r	r	r	0	r	r	r	r	r	r	+	+	r	0	r	0	r	+	r	r	r	r	r	r	r
DIUN	0	0	0	0	r	r	0	0	0	r	r	r	r	r	r	+	+	r	r	r	0	0	r	r	r	r	r	r	r	0
HYSP	+	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	+	r
PLSC	37	58	59	35	32	8	3	0	+	39	25	31	43	29	10	22	25	4	38	43	18	42	21	20	41	38	4	5	45	15
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	r	0	r	0	0	0	0	0
PTCR	0	0	2	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	+	0	0	0	0	0	0	0	0
CLADINA	0	r	0	r	r	+	+	r	r	+	r	r	r	r	r	r	2	r	r	r	r	r	+	r	+	+	r	+	r	r
CLADON.	0	0	0	0	r	0	r	0	r	0	r	0	0	r	r	r	r	r	0	0	0	r	r	r	r	r	r	0	0	r
PELT.	r	+	2	r	r	r	r	r	r	r	+	2	+	2	2	2	r	+	r	0	2	+	+	+	+	+	+	+	+	2
STEREO.	r	0	0	r	0	0	0	r	r	0	r	r	0	r	0	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r

Table B-4. continued (Sunwapta understorey 1989)

Species	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SNCA	6	6	6	2	15	19	9	28	12	9	11	14	13	9	4	8	4	7	3	5	8	4	8	10	8	6	11	5	14	12
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	12	40	7	8	7	r	0	r	6	3	0	r	2	0	0	4	5	10	2	+	3	4	10	6	4	5	6	4	r	7
ROAC	r	+	+	+	+	+	+	r	+	0	r	r	r	+	+	+	+	+	+	+	+	+	+	+	2	+	r	+	+	+
SALIX	0	0	0	0	0	0	0	0	0	r	1	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	3	3	4	3	4	+	3	0	0	0	0	0	3	2	3	3	0	2	3	+	2	2	+	3	2	+	+	+	+	+
LIBO	5	3	3	5	6	5	5	4	5	4	3	4	6	5	5	5	3	4	4	7	6	10	7	5	5	2	5	5	5	5
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	0	0	0
VACA	r	3	+	r	4	3	r	r	r	0	0	r	r	0	r	2	2	3	2	+	3	3	4	2	+	4	3	r	2	2
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	r	+
VAVI	0	0	0	0	0	0	0	2	3	4	3	4	+	0	0	r	+	0	0	0	0	0	0	0	0	0	2	0	0	0
JUMO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
FRVI	r	2	+	+	+	2	2	+	r	2	r	+	2	2	3	3	2	2	+	+	2	4	3	+	+	r	r	+	0	0
CHUM	0	0	0	0	0	r	0	3	r	r	0	0	0	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
ORSE	+	+	0	r	r	+	r	r	0	r	r	0	0	r	+	+	r	r	+	0	+	r	r	r	r	+	+	+	+	r
PYCH	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	0
COCA	0	0	0	r	0	0	0	3	2	+	4	2	0	0	0	0	+	0	0	0	0	0	0	0	+	+	0	r	r	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	r	r	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0
ANRO	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	r	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ASCI	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	r	r	r	r	+	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOSP.	r	r	r	r	r	r	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	r	r	0	0	0	r	r	r	0	0	r	0	0	0	0
MELI	r	r	+	r	r	r	r	0	0	r	0	r	+	+	+	r	+	+	+	+	r	+	r	+	+	+	+	+	r	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	r	0	r	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	r	r	0	0	r	0	0	0	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	3	4	5	5	4	5	4	+	4	5	5	5	5	5	4	5	5	4	4	5	5	4	4	4	4	4	4	4	4
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	3	r	2	0	0	0	0
DIPO	0	r	+	0	r	r	r	+	0	0	0	0	0	r	r	r	+	0	r	r	r	r	r	0	0	0	r	r	0	0
DIUN	r	r	r	r	0	r	r	0	0	0	0	0	0	r	r	r	0	+	r	r	r	r	r	r	r	0	r	r	r	r
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	+
PLSC	27	36	4	8	40	42	35	42	71	35	71	52	53	52	38	12	69	65	33	71	52	33	66	21	68	73	65	48	49	38
POJU	0	r	r	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	r	r	r	r	0
PTCR	0	0	0	0	0	0	0	0	2	0	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	+
CLADINA	r	+	+	+	r	r	r	0	0	0	0	0	0	r	+	+	+	+	+	+	r	+	r	r	r	r	+	r	0	0
CLADON.	0	0	0	r	0	r	r	0	r	0	0	0	0	r	0	0	0	r	r	0	0	0	0	0	0	r	r	0	0	r
PELT.	+	r	r	r	+	+	+	+	+	8	6	2	r	+	+	+	r	+	0	+	+	+	r	+	2	r	+	2	2	2
STEREO.	0	0	r	r	0	0	r	0	0	0	0	0	0	r	r	r	0	0	r	0	r	r	r	0	r	r	r	r	0	0

Table B-4. continued (Sunwapta understorey 1989)

Species	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
SHCA	10	16	8	13	12	13	6	15	4	4	6	8	12	5	12	2	8	9	7	17	22	10	16	18	10	13	7	3	9	12
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	3	2	0	7	7	7	4	0	2	4	4	0	7	8	11	10	+	6	2	+	2	3	2	2	9	14	25	15	2	5
ROAC	+	r	+	0	r	2	+	2	+	+	+	+	+	+	+	+	+	r	+	+	r	r	+	+	+	+	+	+	+	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	r	r	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	3	2	+	0	3	4	3	3	3	3	3	5	3	2	3	4	2	3	3	0	2	2	2	3	0	+	2	4	3
LIBO	5	6	5	4	+	4	4	5	8	8	5	6	3	4	5	6	7	5	4	4	3	5	6	6	6	4	5	6	5	5
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
VACA	+	2	2	3	+	2	2	2	+	+	2	3	2	3	3	4	3	0	2	3	2	3	r	2	3	2	3	3	3	2
VAMY	r	0	r	r	r	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
VAVI	0	0	0	r	0	0	0	0	0	0	+	+	r	2	0	0	0	0	3	2	+	+	0	0	0	0	r	2	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRVI	0	0	2	+	r	0	+	0	+	+	+	+	+	+	r	r	+	2	3	2	+	2	+	+	2	+	r	+	2	+
CHUM	0	r	0	r	0	0	0	0	0	0	r	0	0	0	r	0	r	r	0	0	0	0	+	0	0	0	0	0	0	r
ORSE	r	2	+	+	0	0	r	r	r	0	r	r	+	0	r	+	0	r	+	r	0	0	+	2	+	r	r	r	r	0
PYCH	0	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	r	r	0	r	r	0	r	r	r	r	r
COCA	0	0	2	2	r	r	0	0	0	0	0	0	0	r	r	0	r	+	4	6	5	4	+	0	0	0	0	0	0	r
ACMI	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	2	+	r	2	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	+	+	0	r	r	r	r	0	+	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	r	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	+	r	+	r	+	+	+	r	+	+	+	+	r	+	r	+	r	+	+	r	0	0	0	r	+	0	r	r	+	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	r	r	r	0	0	0	0	r	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	4	4	4	3	4	5	0	5	5	5	5	4	4	4	4	4	4	4	3	2	4	4	3	4	2	3	4	5	5
LYCO	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0
DIPO	r	r	r	r	r	r	r	r	r	0	r	0	r	r	r	r	0	0	0	0	0	r	0	2	0	0	0	0	r	0
DIUN	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r	0	0	r	0	0	0	0	0	0	r	0	0	0	r	0
HYSP	0	2	5	0	5	3	0	0	0	0	0	0	r	0	4	r	r	0	r	3	0	0	0	0	0	0	0	0	0	0
PLSC	3	45	72	50	67	70	62	44	29	44	68	48	15	57	70	52	69	42	30	60	8	58	76	61	57	43	62	51	39	68
POJU	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	+	0	0	0	r	r	0	0	0	r	+	0	+	0	0	0	0	+	+	r	+	0	0	2	0	0	0	0
CLADINA	r	0	r	r	r	r	r	r	r	+	r	+	r	r	+	+	r	r	r	0	0	r	0	0	r	0	r	r	r	0
CLADON.	r	0	0	r	r	r	r	r	r	r	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	r	r	0	r
PELT.	5	3	+	r	+	+	+	2	2	+	+	+	r	2	+	r	+	5	5	r	r	3	7	+	+	r	r	+	2	r
STEREO.	0	r	r	0	r	0	0	0	r	r	r	0	r	r	0	r	r	0	0	0	0	0	0	0	r	0	0	0	r	0

Table B-4. continued (Sunwapta understorey 1989)

Species	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
SHCA	8	6	12	7	16	14	14	16	16	4	8	8	21	11	10	16	11	8	5	8	6	15	8	11	13	13	12	19	13	18
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	6	7	5	+	2	2	2	28	3	4	11	4	15	7	7	2	+	11	2	3	2	12	13	20	3	4	15	12	2	2
ROAC	r	+	+	+	+	+	r	+	r	+	+	+	0	+	2	2	2	+	+	+	+	+	+	+	+	+	+	r	r	+
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	3	3	5	4	+	+	2	4	4	3	3	5	+	4	+	4	4	3	5	2	2	2	3	3	3	4	2	+	2	2
LIBO	5	7	3	4	4	4	5	4	4	7	4	5	2	3	12	5	4	3	5	3	5	6	5	4	5	5	6	5	4	3
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	+	+	+	r	+	2	+	+	+	r	2	+	+	+	+	2	+	3	+	r	+	3	2	2	2	+	3	2	r	3
VAMY	r	0	r	r	r	0	0	r	0	0	+	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
VAVI	0	0	0	0	0	0	0	0	0	0	r	+	+	0	0	0	0	0	0	0	0	r	+	0	0	0	2	2	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	+	r	r	r	0	0	0	r	r	+	r	+	r	r	0	0	r	r	+	+	r	r	+	+	6	+	+	r	2	2
CHUM	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	r	r	0	0
ORSE	+	+	0	0	0	0	+	+	+	r	r	r	r	+	r	0	r	r	0	r	r	r	r	r	r	r	+	+	r	0
PYCH	r	r	r	0	0	0	0	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	0	r	r	0
COCA	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	r	+	2	7
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
ANHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
ASCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	+	+	r	+	r
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	0	r	0	0	r	r	0	r	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	+	+	+	+	2	+	+	+	+	+	+	+	r	+	+	+	+	+	+	+	+	+	+	+	+	+	r	r	+	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
GOOB	r	0	0	0	0	0	0	0	0	r	r	r	r	0	r	r	0	r	0	0	+	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	4	4	5	4	4	4	4	4	4	4	4	3	4	3	4	6	4	8	8	7	6	4	4	5	5	3	3	5	5
LYCO	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	r	r	r	0	0	r	0	0	+	+	r	0	r	r	r	r	0	r	r	r	r	r	r	r	r	0	0	0	0
DIUN	0	r	r	+	r	r	r	r	+	r	+	+	r	+	r	r	r	+	r	r	+	r	r	r	r	0	0	0	0	0
HYSP	0	0	0	0	0	0	3	0	r	r	0	+	2	0	0	r	0	r	0	0	0	0	0	r	r	3	2	2	+	+
PLSC	38	42	29	31	22	28	33	48	42	13	25	34	57	16	6	7	4	12	10	48	44	10	18	34	45	64	75	69	59	51
POJU	0	r	0	0	0	0	r	r	0	r	r	r	0	r	r	r	r	r	r	r	0	r	0	r	0	0	0	0	0	0
PTCR	0	0	0	0	r	r	0	0	+	+	r	0	2	0	0	r	0	0	0	0	0	0	0	r	+	0	0	r	r	0
CLADINA	r	+	2	+	r	r	r	+	r	+	3	3	r	+	r	r	r	+	2	+	0	r	r	+	r	r	0	0	r	r
CLADON.	r	r	r	r	r	+	r	r	r	r	+	r	+	+	r	r	+	+	r	r	r	r	r	r	r	r	0	r	r	0
PELT.	+	+	+	+	3	2	r	2	+	+	2	2	+	2	2	3	2	2	+	+	+	+	+	+	+	+	+	+	+	r
STEREO.	0	r	0	r	r	r	r	0	r	r	0	0	0	r	r	r	r	+	0	0	0	0	0	0	r	0	0	0	0	0

Table B-4. continued (Sunwapta understorey 1989)

Species	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
SHCA	14	16	12	15	12	19	7	7	14	10	7	4	12	11	6	8	6	10	8	8	9	7	15	13	6	3	10	8	3	6
LEGR	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	3	7	11	5	5	+	2	6	3	2	3	5	3	2	7	2	3	5	5	4	6	+	+	+	+	0	0	3	13
ROAC	r	+	r	+	+	+	r	+	r	r	+	r	r	+	+	r	+	r	r	+	+	+	2	r	+	+	+	+	+	+
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	3	5	5	3	4	+	2	+	2	4	4	3	3	5	3	2	3	4	+	3	2	5	4	+	+	2	0	3	3	2
LIBO	6	5	4	4	7	3	4	5	5	4	5	5	5	4	5	4	5	4	5	5	2	2	4	4	5	7	5	3	6	5
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	r	0	0	0	0	+	2	2	2	+	2	+	+	2	r	r	+	+	2	2	2	2	r	+	+	2	+	+	2	3
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	r	0	0
VAVI	0	+	2	+	0	0	r	0	r	r	0	0	0	0	0	0	0	+	0	0	0	0	0	0	r	0	0	r	r	+
JUNO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRVI	+	+	+	+	+	+	+	+	r	0	0	3	+	0	+	r	0	+	0	2	3	r	0	0	+	2	0	+	+	+
CHUM	0	0	0	0	r	0	+	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ORSE	0	r	0	2	r	r	r	r	r	r	r	0	r	r	0	r	r	r	0	+	0	r	+	r	+	0	+	0	0	0
PYCH	0	r	0	0	r	r	0	r	r	0	0	0	r	r	0	r	0	0	0	0	0	r	r	r	r	r	r	r	r	0
COCA	4	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	r	0	0	0	0	0	0	+	r	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
ASCI	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	r	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	r	r	r	+	+	r	+	+	r	+	+	+	+	+	+	2	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GELI	0	0	0	0	0	0	0	0	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	0	r	r	r	r	0	r	0	r	r	0	0	r	r	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	4	r	4	3	4	6	4	4	6	5	5	4	5	5	5	4	4	4	4	4	4	4	6	7	6	6	6	5	5
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0
DIPO	0	0	0	0	r	0	r	r	r	r	r	r	r	r	+	r	r	r	0	r	0	r	r	r	0	r	0	r	r	0
DIUN	r	0	0	0	r	0	r	r	r	r	r	r	+	r	+	0	0	r	0	r	r	r	r	r	r	0	0	r	r	r
HYSP	0	0	+	+	0	2	r	r	r	0	0	0	0	r	0	+	+	+	+	r	+	r	r	r	+	0	+	0	r	4
PLSC	17	38	53	35	24	20	65	55	42	55	21	15	70	41	3	15	52	53	63	13	+	22	15	18	35	42	15	38	27	63
POJU	0	0	0	0	0	0	0	r	0	r	0	r	0	0	r	r	0	r	0	r	r	r	r	r	r	0	r	r	r	0
PTCR	0	0	+	+	0	+	r	r	2	0	r	0	0	0	0	0	r	r	+	r	0	0	0	0	0	0	+	r	0	0
CLADINA	r	r	r	0	0	r	r	r	r	r	r	2	2	r	r	+	+	+	2	+	2	+	r	r	2	2	r	2	2	+
CLADON.	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r	r	r	r
PELT.	+	2	+	2	+	+	2	+	+	+	+	+	2	+	+	+	+	+	r	+	+	+	r	2	0	2	+	+	+	+
STEREO.	0	0	0	0	r	r	r	r	r	r	0	0	0	r	0	0	0	r	+	0	0	r	0	r	r	0	r	0	r	r

Table B-4. continued (Sunwapta understorey 1989)

Species	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SHCA	12	8	7	5	17	9	7	15	+	7	4	4	9	16	8	13	17	8	15	14	13	12	12	8	10	12	9	6	5	14
LEGR	0	0	0	0	0	0	0	0	0	0	2	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	6	7	3	4	6	2	2	4	5	4	+	+	r	+	6	0	r	2	5	13	4	2	3	2	+	0	0	r	4	4
ROAC	r	+	+	r	r	r	+	+	r	0	0	+	r	r	+	r	0	0	+	+	+	+	+	+	r	0	r	+	+	+
SALIX	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	4	3	4	3	3	3	3	2	4	3	3	3	2	2	+	4	3	3	2	4	3	2	2	+	r	2	3	2	+	3
LIBO	6	5	5	5	4	8	6	5	4	4	6	4	4	5	8	3	5	5	3	3	4	4	5	4	5	4	4	4	4	6
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	3	2	2	+	r	0	0	0	2	+	0	+	+	2	+	2	3	2	3	4	3	3	3	+	3	+	3	+	r	+
VAMY	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
VAVI	+	r	r	0	0	0	3	5	3	2	3	3	5	3	r	0	0	0	0	0	0	+	4	r	0	0	0	0	0	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	+	+	r	r	+	2	+	+	2	3	+	2	2	+	+	2	2	2	+	+	+	+	r	+	+	r	3	0	3
CHUM	0	r	r	0	r	0	0	0	0	r	0	0	0	r	0	0	0	r	0	0	+	0	0	0	r	0	0	0	0	0
ORSE	+	+	+	r	+	+	+	+	0	r	r	0	r	r	r	r	+	+	+	+	+	r	r	r	+	+	r	r	0	r
PYCH	r	0	r	r	r	r	r	0	r	0	0	0	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
COCA	0	0	0	0	0	+	0	r	r	+	+	r	r	0	r	2	r	r	0	0	0	0	0	0	0	0	0	0	+	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	0	r	0	r	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	+	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
ASCI	0	0	0	0	0	0	0	0	r	0	r	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	r	r	0	0	r	r	r	0	0	r	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	r	+	r	r	r	r	r	+	+	+	+	+
GELI	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	r	r	0	r	0	0	0	0	0	0	0	0	r	0	0	0	r	r	0	0	0	r	0	0	r	r	0	r	r	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	5	5	4	2	4	4	4	5	4	5	5	4	4	4	4	4	5	4	4	4	4	4	5	5	5	5	4	4	4
LYCO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	r	r	0	r	r	0	0	0	r	r	r	r	r	0	0	r	0	0	0	0	r	r	r	r	0	r	r	r
DIUN	0	0	r	r	0	r	r	0	0	0	r	0	r	r	r	0	0	r	0	0	0	0	r	0	r	0	r	r	+	r
HYSP	+	r	0	r	2	r	0	+	r	2	r	r	0	+	0	r	+	r	2	r	r	+	+	0	r	r	0	r	r	r
PLSC	60	62	52	57	6	21	11	65	54	61	65	69	70	55	6	10	17	41	68	52	68	78	65	55	61	45	24	4	34	30
POJU	0	r	r	r	0	r	r	0	0	0	r	0	r	0	r	0	r	r	0	0	0	0	r	0	0	r	r	r	0	r
PTCR	0	0	0	0	r	r	0	r	0	r	0	0	0	0	0	0	0	0	4	5	5	4	2	+	2	0	0	0	0	0
CLADINA	r	+	r	r	r	r	r	r	+	r	r	r	+	r	+	r	+	r	0	r	0	r	r	r	r	2	+	2	+	+
CLADON.	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r
PELT.	+	+	+	+	r	+	2	+	2	+	0.9	+	+	+	+	+	+	+	r	r	r	r	+	+	r	+	+	+	+	+
STEREO.	r	r	0	r	r	r	0	0	r	r	r	r	r	0	0	0	r	0	r	r	r	0	r	0	0	0	0	r	r	r

Table B-4. continued (Sunwapta understorey 1989)

Species	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
SHCA	9	7	4	8	7	15	15	16	13	9	9	10	7	16	5	6	7	15	13	11	9	13	5	7	3	6	11	14	10	11
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	2	0	0	0	2	r	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	r	0	0	+	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	2	2	r	2	+	r	4	2	2	r	+	2	7	3	3	2	r	+	4	9	15	5	5	r	3	7	r	4	3	2
ROAC	+	+	r	r	r	r	+	r	+	+	r	r	r	0	r	0	r	r	0	0	0	r	r	r	0	+	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	+	+	2	3	3	r	r	2	3	+	r	+	3	+	3	3	4	2	2	+	+	3	r	2	+	3	+	2	3
LIBO	3	3	4	4	5	5	4	5	4	6	5	4	4	4	4	6	4	3	3	3	3	4	5	4	3	3	3	5	5	4
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0
VACA	r	r	3	2	r	2	3	2	+	+	+	r	3	r	+	r	+	r	+	+	+	+	r	+	+	3	3	2	3	2
VAMY	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAVI	0	0	0	0	r	0	r	2	3	3	3	r	0	0	2	+	2	2	4	3	+	2	+	+	+	+	+	0	+	0
JUHO	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	+	r	r	r	r	r	0	r	r	r	r	r	2	2	2	3	3	+	r	2	+	+	+	2	4	2	+	+	2	r
CHUM	0	r	0	0	0	0	r	r	0	0	0	r	0	0	0	0	0	r	0	r	0	0	0	0	0	r	0	r	r	r
ORSE	r	r	r	r	0	+	r	r	r	r	r	+	r	+	+	0	r	r	r	r	r	0	r	0	r	r	0	r	+	r
PYCH	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	0	r	r	r	r	r	r
COCA	2	r	0	0	0	r	0	0	0	0	0	r	2	+	+	+	0	0	r	+	+	3	0	+	r	0	0	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANMO	0	0	0	0	0	0	r	0	0	0	0	r	r	r	r	r	r	0	0	r	0	0	r	r	+	0	r	0	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	r	0	r	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	+	0	r	r	0	0
ASCI	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0
ASCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	0	r	0	0	0	0	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
MELI	+	+	+	+	2	+	+	r	r	2	+	+	r	+	+	+	+	+	r	r	r	r	+	r	r	r	r	+	r	r
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	r	0	0	0	0	0	0	0	0	r	0	0	0	r	0	r	r	0	0	0	0	0	r	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
GOOB	r	r	r	r	0	0	r	r	r	r	0	r	r	r	r	0	0	r	0	0	r	0	r	r	0	r	r	r	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	5	5	5	5	5	5	4	5	6	5	4	4	4	4	5	6	4	4	3	3	4	4	4	5	3	4	4	4	4
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	2	0	0	r	0	0	0	0	r	0
DIPO	r	r	r	r	r	0	0	0	r	r	r	r	r	r	r	r	r	r	0	0	0	r	r	r	r	r	r	r	0	0
DIUN	r	r	r	r	r	0	0	0	r	0	r	r	r	r	r	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0
HYSP	0	+	3	4	+	2	4	4	2	4	4	5	4	10	2	+	r	r	+	+	r	+	0	0	+	8	15	4	6	8
PLSC	63	65	68	65	8	45	62	58	53	39	59	58	59	33	32	24	20	32	55	59	65	26	11	65	54	61	60	49	58	57
POJU	0	r	0	0	r	0	r	0	r	0	0	0	r	0	0	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0
PTCR	0	0	0	0	0	2	+	2	4	+	0	+	0	+	0	r	0	0	0	0	+	0	0	2	0	+	0	2	3	5
CLADINA	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r	0	r	+	r	+	0	r	r	r	r
CLADON.	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	0	r	r	0	r
PELT.	r	+	+	+	4	+	+	r	+	+	+	+	+	+	2	2	2	+	+	+	+	r	+	+	+	+	r	+	r	+
STEREO.	r	r	0	r	0	r	0	0	r	r	r	r	r	r	r	r	0	r	0	r	r	r	0	r	r	0	0	0	0	0

Table B-4. continued (Sunwapta understorey 1989)

Species	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
SHCA	9	13	15	14	9	4	9	7	7	6	12	9	8	5	9	15	16	15	19	15	13	14	17	17	13	5	11	5	12	12
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	r	0	0
MEPE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	+	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	4	5	2	3	10	5	+	0	r	7	r	4	10	+	+	8	15	3	9	4	8	2	8	2	2	4	r	9	6	2
ROAC	0	+	+	+	r	r	0	r	+	+	r	+	r	r	0	+	r	+	0	0	0	+	0	0	0	0	0	+	r	0
SALIX	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AROV	+	+	3	+	3	3	2	3	2	3	3	+	+	3	3	2	2	3	2	2	3	2	3	0	3	4	3	+	2	2
LIBO	5	4	5	3	3	3	4	6	5	5	6	4	4	6	5	3	4	4	5	4	4	3	4	3	4	4	4	6	5	5
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	+	2	+	2	3	2	+	r	r	+	r	0	r	r	r	3	2	r	r	r	2	3	2	3	+	r	+	+	r	r
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	r	0	0
VAVI	r	2	2	r	+	3	r	0	0	0	0	0	0	0	+	+	0	0	r	3	0	+	2	0	r	r	r	0	2	3
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	+	r	r	r	r	r	3	2	r	r	r	r	2	2	r	r	r	+	3	3	+	2	3	4	2	3	r	r
CHUM	0	0	r	0	0	r	+	0	r	0	0	r	0	0	r	0	0	0	0	0	0	r	r	0	r	0	0	0	0	0
ORSE	r	r	r	r	r	r	r	0	0	0	r	0	0	0	r	0	r	0	r	r	+	r	r	r	r	r	+	0	r	0
PYCH	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	0	r	r	0	r	r	r
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	0	0	0	0	r	r	r	0	0	0	r	r	r	0	0	0	0	0	0	r	0	r	0	+	r	+	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	r	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r
ASCO	0	0	0	0	0	0	r	0	0	r	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r	+
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
MELI	+	+	+	+	+	r	+	+	+	+	+	+	+	+	+	+	r	+	2	r	+	+	r	+	+	+	r	+	+	+
GELI	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	r	r	0	0	r	r	r	r	0	r	r	r	r	r	r	r	0	0	r	0	0	0	0	r	0	r	r	0	r	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	4	4	5	5	5	5	4	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	+
DIPO	0	r	0	0	0	r	r	r	r	0	r	r	r	0	r	0	0	0	0	0	0	r	0	0	0	0	0	r	r	r
DIUN	0	0	0	r	0	r	r	r	r	r	r	r	r	r	r	0	0	0	0	r	0	0	0	0	0	0	0	r	r	0
HYSP	2	2	5	3	5	r	+	+	+	r	+	0	0	r	+	0	0	3	2	2	2	3	+	0	2	2	+	r	r	r
PLSC	62	62	48	35	10	26	62	7	4	7	5	5	11	17	25	7	55	29	29	51	72	75	73	69	65	35	39	40	31	45
POJU	0	0	r	0	0	0	0	r	r	r	r	r	r	0	r	r	0	r	0	0	0	0	0	0	0	0	0	r	0	0
PTCR	+	0	3	2	0	0	0	0	r	0	+	0	r	0	0	2	2	0	0	+	0	2	+	+	r	2	r	r	r	0
CLADINA	r	r	r	r	r	+	r	+	r	r	r	r	r	+	+	+	r	r	0	r	r	r	r	r	r	r	0	r	r	r
CLADON.	r	r	r	r	r	r	r	r	r	0	r	0	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r
PELT.	+	r	+	+	+	+	+	+	r	+	+	+	2	r	+	r	r	2	2	+	2	r	+	+	+	r	+	0	0	+
STEREO.	r	r	0	r	0	r	r	r	0	r	r	r	r	r	0	r	0	0	0	0	r	0	0	r	r	0	0	r	r	r

Table B-4. continued (Sunwapta understorey 1989)

Species	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
SHCA	12	15	11	8	9	9	14	14	16	15	12	15	10	13	5	2	10	15	7	5	14	10	13	2	6	10	13	11	11	7
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFZ	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	0	2	+	2	+	5	+	5	2	6	6	7	12	+	19	10	+	3	5	2	8	8	14	8	7	12	10	6	13
ROAC	r	+	+	0	0	0	0	0	0	r	0	r	+	r	+	2	+	0	+	+	2	+	r	r	+	2	+	+	0	0
SALIX	0	0	0	0	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	2	r	+	+	+	+	2	3	2	+	2	3	3	2	3	+	3	4	2	3	0	2	2	+	3	4	3	3	2	2
LIBO	3	3	4	4	6	5	3	3	3	4	4	5	7	5	3	2	3	4	5	6	4	3	3	3	2	3	5	9	3	4
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	2	r	2	3	2	2	+	+	3	2	r	r	+	2	2	0	0	r	r	0	r	r	r	0	r	r	2	+	r	3
VAMY	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VAVI	+	4	0	2	3	+	0	3	3	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	+	0	0	0	0	0	0	0	0
FRVI	+	2	+	3	4	4	+	r	2	r	+	+	+	+	r	r	r	r	+	r	+	r	+	+	r	+	+	2	2	+
CHUM	0	r	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	r	r	r	+	r	0	r	0	+	0	r	0	r	r	0	0	+	r	0	r	r	0	0	0	0	0	r	r	r
PYCH	r	0	0	r	0	r	r	r	r	r	0	r	0	0	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r
COCA	r	0	r	2	0	+	+	0	0	0	0	0	0	0	0	0	0	0	0	r	3	r	0	0	r	0	0	0	0	0
ACMI	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
ANHO	0	0	r	r	0	+	r	r	0	0	0	0	r	0	r	r	r	r	r	0	0	r	r	r	r	0	0	r	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0
ARCO	0	r	0	0	0	0	0	0	0	0	r	0	0	r	+	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0
ASCO	+	+	0	0	0	0	0	0	0	0	0	r	r	+	r	0	0	0	0	0	0	0	0	0	0	0	r	+	+	0
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	r	r	r	r	0	0	r	r	r	0	0	r	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	r	r	+	r	r	+	+	+	+	+	+	2	+	r	+	+	+	+	+	+	+	+	+	r	+	+	2	+	+	+
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	r	r	0	0	0	r	r	r	r	r	r	0	r	0	r	0	0	0	0	0	0	r	0	0	0	r	0	r	r
HAOB	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	5	4	4	4	4	4	4	4	5	4	4	4	4	5	+	2	4	4	4	3	4	4	+	2	4	4	4	4	3
LYCO	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0
DIPO	0	r	0	0	0	0	+	0	0	r	r	0	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r	r	0
DIUN	0	0	0	0	0	0	r	0	0	0	r	r	r	r	0	r	r	0	r	r	r	r	r	r	r	r	0	0	r	0
HYSP	5	r	3	4	6	2	6	3	6	4	3	r	+	+	0	0	0	+	0	0	2	3	0	0	0	0	0	0	0	+
PLSC	60	58	58	62	54	60	51	29	61	60	36	38	10	38	12	6	+	0	2	+	39	20	12	2	0	4	2	12	14	10
POJU	0	0	0	0	0	r	0	r	0	0	0	r	0	0	r	r	r	r	r	r	r	r	r	0	r	r	r	0	0	0
PTCR	2	+	0	6	+	0	+	0	r	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	0	r	r	0	0	0	r	r	r	r	+	+	+	+	2	2	r	r	+	r	r	r	r	+	0	+	+	2	+	+
CLADON.	r	r	r	0	0	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	+	+	r	+	0	r	+	r	r
PELT.	r	+	+	0	+	+	+	2	+	2	+	+	+	r	+	+	r	+	+	2	+	+	r	0	r	+	+	+	+	+
STEREO.	0	0	0	0	0	r	r	0	r	0	r	r	r	0	r	0	r	r	0	0	+	r	r	r	r	0	0	0	0	r

Table B-4. continued (Sunwapta understorey 1989)

Species	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
SHCA	9	14	12	7	12	9	8	2	14	12	11	11	10	12	15	14	10	5	13	11	9	6	10	12	12	9	8	12	17	10
LEGR	0	0	0	0	0	3	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEPE	0	0	0	0	0	+	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	5	6	r	3	2	2	3	3	r	0	0	0	0	3	2	8	3	2	8	5	3	5	+	2	+	5	9	6	12	8
ROAC	0	r	0	0	0	+	r	0	r	r	+	0	r	r	0	0	0	0	0	0	0	+	+	2	2	2	+	+	+	+
SALIX	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	r	r	r	0	0	r	0	0	r	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	4	2	3	3	+	+	+	+	r	+	2	+	+	+	+	2	2	2	2	3	+	+	2	2	+	2	+	r	2	r
LIBO	3	3	4	11	4	4	4	4	3	3	3	6	4	4	2	4	5	5	3	5	4	4	5	5	4	6	5	3	4	5
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACA	+	r	+	2	2	2	2	2	+	0	0	2	+	+	+	r	0	0	+	+	+	r	+	r	+	r	r	+	r	r
VAMY	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	r	0	r	r	0	0	0
VAVI	0	2	2	0	3	3	4	3	0	0	0	0	3	3	2	0	2	3	0	0	0	0	0	0	0	0	0	+	r	0
JUHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
FRVI	+	r	r	+	2	2	3	3	3	2	3	0	2	+	2	r	+	+	2	3	3	+	+	r	r	+	+	2	+	0
CHUM	0	0	0	0	r	r	+	r	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ORSE	r	r	0	0	0	r	r	r	r	+	+	r	r	r	r	+	r	0	r	0	r	r	+	r	r	0	r	r	0	r
PYCH	r	r	0	0	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	0	0	r	0	r	0	r	r	r	r
COCA	0	0	0	0	0	0	+	2	2	0	r	+	+	0	0	0	0	0	0	0	+	0	0	0	0	0	r	+	+	+
ACMI	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	r	+	r	r	0	r	0	0	0	0	r	0	r	+	r	+	r	r	0	r	0	0	r	0	r	0	r	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0
ASCI	0	0	0	0	r	+	r	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	0	0	r	0	0	r	0	0	0	r	0	0	0	0	0	0	0	r	r	r	r	0	0	r	0	r
SEST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	r	0	0	0	0	0	r	0	r	0	r	0	r	r	0	r	0	0	0	r	0	r	r	0	r	r	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELI	+	+	r	+	r	r	r	+	r	r	+	r	r	+	+	r	+	r	+	+	+	+	+	+	+	+	+	+	+	+
GELI	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
GOOB	r	r	r	r	0	r	0	0	0	r	r	0	0	0	0	0	0	r	r	r	r	0	r	r	0	r	r	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	4	4	3	4	4	4	4	5	4	5	5	4	3	5	4	4	4	4	4	4	4	4	5	4	3	4	4	3	4
LYCO	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	+	0	+	r	0	0	0	r	0	0	r	0	0	r
DIPO	0	r	r	r	0	0	0	+	0	0	r	r	r	0	0	0	r	r	0	0	r	r	r	r	0	r	r	r	r	0
DIUN	r	r	0	r	0	0	0	0	r	0	0	0	0	0	0	r	0	r	r	r	r	r	r	r	r	r	r	r	0	0
HYSP	0	+	r	+	4	3	+	3	6	4	2	0	r	+	0	2	r	0	0	+	0	0	0	0	0	0	+	2	0	+
PLSC	3	15	4	13	62	65	29	68	24	66	6	11	52	61	39	14	35	31	10	42	20	16	25	35	4	2	20	45	28	29
POJU	0	0	0	r	0	0	0	r	0	0	0	r	0	0	0	0	r	0	r	r	r	r	r	0	r	r	0	0	r	0
PTCR	r	+	0	0	0	+	2	0	0	0	0	0	+	+	3	r	0	0	0	+	0	0	0	0	0	0	0	0	r	0
CLADINA	r	r	r	r	r	0	r	r	0	r	r	r	r	r	r	r	+	+	+	+	+	+	2	r	0	0	r	r	r	0
CLADON.	r	r	r	r	r	0	0	0	0	r	r	0	0	r	r	r	+	r	0	r	r	r	r	r	r	0	r	r	r	r
PELT.	+	2	+	2	2	2	+	0	0	r	+	r	+	+	+	+	2	+	+	+	+	r	r	r	r	r	+	r	r	r
STEREO.	0	r	r	0	r	0	0	0	0	0	r	r	0	r	r	0	0	r	0	r	0	0	0	r	0	r	r	0	0	r

Table B-4. continued (Sunwapta understorey 1989)

Species	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
SNCA	10	6	13	4	3	7	10	6	11	13	13	10	16	8	10	13	6	17	9	2	5	4	16	3	4	5	5	7	15	9
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	3	0	+	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0
JUCO	3	7	17	15	3	2	3	4	r	+	4	1	4	7	4	r	2	0	0	0	5	5	8	0	3	2	+	7	2	3
ROAC	+	+	2	+	2	2	2	+	0	0	0	0	+	0	0	0	0	0	0	r	+	0	0	0	+	r	0	r	+	0
SALIX	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0	0	0	r	0	0	r	r	r	r	0	r	+	r	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	+	3	2	2	3	3	2	2	+	2	2	+	+	3	r	3	4	3	+	+	+	r	r	+	r	r	0	+	2
LIBO	4	4	3	4	3	5	5	5	5	3	5	6	4	4	5	3	5	4	4	4	4	3	3	4	4	4	4	3	4	4
CAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
VACA	r	r	r	0	0	r	0	r	+	2	r	r	r	+	r	+	r	+	r	r	r	+	+	+	2	+	+	r	2	r
VAMY	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	r	r	0	0	0	0	0
VAVI	0	0	0	0	0	0	0	0	0	0	0	+	2	2	+	0	+	r	r	r	0	0	0	r	+	+	2	+	3	0
JUNO	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
FRVI	+	r	r	r	4	+	3	2	r	+	2	+	2	+	+	2	2	+	+	3	+	2	r	3	2	+	3	r	2	2
CNUM	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	r	r	r	0	r	r	r	0	r	0	0	r
ORSE	0	r	r	r	0	+	r	0	r	r	r	r	r	r	r	r	0	0	r	r	0	r	r	r	0	+	+	r	r	0
PYCH	r	r	r	r	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r
COCA	+	3	+	+	0	0	0	0	+	2	0	0	0	0	0	r	r	r	r	0	0	r	0	0	r	0	0	+	0	r
ACMI	0	0	0	0	r	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0
ANHO	r	0	0	r	0	r	r	0	0	0	r	r	r	+	r	r	0	0	r	r	0	r	0	r	0	r	r	0	r	r
ANRO	0	0	0	r	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
ASCI	r	0	0	r	r	0	0	0	r	0	r	0	0	0	r	0	r	0	0	r	0	0	0	0	r	r	0	0	0	r
ASCO	r	r	0	0	r	0	r	r	0	0	0	0	0	0	r	0	r	0	r	0	0	r	0	0	r	r	0	r	0	0
SEST	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	0	0	r	r	r	r	0	0	0	0	r	r	r	0	r	0	r	r	0	0	0	0	r	r	0	0	0	0
CAMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
MELI	r	r	+	+	+	+	+	+	r	+	+	+	+	+	+	+	+	+	+	+	+	r	+	+	r	r	+	r	+	+
GELI	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	r	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GEAN	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0	r	0	r	r	0	0	0	r	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	r	r	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0	0	r	0	r	r	0	0	0	0	0	r	0
HAOB	0	0	0	0	r	0	r	0	0	0	r	0	0	0	0	0	0	0	r	0	0	r	r	r	0	0	0	r	0	0
HAUN	0	0	0	0	0	0	0	0	r	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	4	4	4	3	4	5	4	4	4	4	5	4	4	4	5	4	5	5	4	4	4	4	4	4	4	3	3	3	4
LYCO	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	0	r	r	0	0	r	r	r	r	r	0	r	r	r	0	0	r	0	0	r	r	0	0	0	0	r	0	0
DIUN	r	0	0	0	r	0	r	0	r	0	r	0	0	0	0	r	r	r	r	0	0	0	r	r	0	0	0	0	0	0
HYSP	0	0	0	0	0	0	0	0	0	0	2	r	2	0	0	0	0	2	0	0	2	+	4	2	2	2	2	+	r	r
PLSC	20	12	5	4	r	3	3	5	10	37	28	47	58	48	42	36	19	10	4	48	38	51	57	35	64	69	61	57	22	29
POJU	r	r	0	r	r	r	r	0	r	0	r	r	r	r	0	r	r	0	r	r	r	r	r	r	r	r	0	0	0	r
PTCR	0	0	0	0	0	0	0	0	0	0	+	0	0	+	0	r	r	3	0	0	0	0	r	0	2	2	2	+	+	0
CLADINA	0	r	0	r	+	0	r	2	+	+	r	r	r	+	r	r	+	r	r	+	+	r	+	r	r	r	r	r	r	r
CLADON.	0	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	r
PELT.	0	2	r	r	r	r	+	r	+	+	+	+	+	+	r	+	+	+	+	+	+	+	+	+	+	r	+	r	+	r
STEREO.	r	r	r	0	r	0	r	0	0	0	r	0	0	r	r	r	+	r	r	0	r	0	r	r	0	0	r	0	0	0

Table B-4. continued (Sunwapta understorey 1989)

Species	391	392	393	394	395	396	397	398	399	400
SHCA	11	10	6	7	8	5	7	11	4	13
LEGR	0	0	0	0	0	0	0	0	0	0
MEFE	0	0	0	0	0	0	0	0	0	0
RHAL	0	0	0	0	0	0	0	0	0	0
JUCO	9	4	6	2	7	0	2	4	3	2
ROAC	r	+	+	+	+	+	+	2	+	2
SALIX	r	r	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0
ARUV	0	r	+	2	+	2	+	2	r	+
LIBO	4	4	4	5	5	5	4	4	4	5
CAME	0	0	0	0	0	0	0	0	0	0
PHYL	0	0	0	0	0	0	0	0	0	0
VACA	2	r	r	0	r	r	r	r	+	0
VAMY	0	0	r	0	0	r	r	r	r	+
VAVI	0	0	0	0	0	0	0	0	0	0
JUHO	0	0	0	0	0	0	0	r	0	0
FRVI	+	2	+	+	r	+	+	r	+	+
CHUM	0	0	0	0	0	0	0	0	0	r
ORSE	+	r	r	0	0	0	0	0	0	+
PYCH	r	0	r	r	r	r	r	r	0	r
COCA	+	0	r	+	0	0	r	r	r	2
ACMI	r	r	r	0	0	0	r	r	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0
ANHO	0	0	0	0	0	0	r	0	0	0
ANRO	0	0	r	0	0	0	0	0	0	0
ARCO	0	0	0	0	r	0	r	0	0	0
ASCI	r	0	0	0	r	0	0	0	0	0
ASCO	0	0	0	0	r	0	0	0	r	r
SEST	0	0	0	0	0	0	0	0	0	0
SOSP.	0	r	r	0	0	0	r	0	0	0
CAMI	0	r	0	0	0	0	0	0	0	0
MELI	+	+	+	+	+	+	+	+	+	+
GELI	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0
GEAM	0	0	r	0	0	0	0	0	0	0
GEPR	0	0	0	0	0	0	0	0	0	0
ANLI	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0
GOOB	0	r	0	0	r	0	0	0	r	r
HAOB	0	0	0	0	0	0	0	0	0	0
HAUN	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0
ELIN	2	4	4	4	3	4	4	4	4	5
LYCO	0	0	3	0	0	r	0	0	0	0
DIPO	r	r	r	r	0	r	r	r	r	r
DIUN	0	0	0	r	0	0	r	r	r	0
HYSP	0	0	0	0	0	0	0	0	0	3
PLSC	27	12	16	3	4	2	5	8	59	52
POJU	0	0	0	r	r	r	r	0	r	r
PTCR	r	0	0	0	0	0	0	0	0	0
CLADINA	r	r	+	r	r	r	+	r	r	0
CLADON.	r	0	r	0	r	r	r	r	r	r
PELT.	r	r	0	+	+	+	+	r	r	0
STEREO.	0	r	0	0	r	r	r	r	r	r

Table B-5. Understorey species cover estimates for Whirlpool 1967.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SHCA	0	0	+	+	+	+	r	+	+	+	+	1	+	+	+	r	r	+	+	+	+	+	+	+	+	+	r	+	+	+
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	0	0	r	r	r	0	0	0	r	0	0	r	r	1	r	+	0	0	r	0	0	0	r	1	2	1	0	0	0
ROAC	r	0	r	r	r	0	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	0	0	r	0	r	r	r	r	r	+	0	r	+	+	0	r	0	0	r	0	0	+	+	r	r	0	+
LIBO	+	+	r	+	+	r	+	+	r	r	1	1	1	1	+	+	+	+	+	+	+	+	+	1	+	r	+	+	+	1
VACA	+	r	0	r	r	r	r	r	+	r	+	+	+	+	+	+	+	+	+	+	r	r	r	r	0	+	2	r	1	+
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	r	0	0	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0
ORSE	r	r	r	r	r	0	r	r	0	r	0	0	0	r	r	r	r	0	0	0	0	r	0	r	+	r	0	0	0	r
PYCH	r	r	0	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r
COCA	1	+	+	r	+	+	r	+	+	+	+	+	+	0	+	0	0	0	0	0	0	0	0	0	0	+	+	+	+	+
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	+	r	r	+	r	r	+	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ASCO	r	0	0	0	0	0	r	0	0	r	r	0	r	r	+	r	r	0	0	0	0	0	0	r	r	r	r	r	r	0
SOSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0
LAOC	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	r	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	r	r	r	r	r	r	r	r	+	+	r	r	+	+	r	r	r	r	+	r	r	r	r	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	r	r	r	r	r	+	r	r	r	r	+	r	+	r	r	r	r	r	r	r	r	+	+	r	+	+	r	r
HYSP	5	6	5	3	+	2	3	1	3	1	3	+	+	+	3	1	4	3	1	4	5	3	1	+	r	2	r	+	+	2
PLSC	r	r	1	2	4	3	3	4	4	5	3	2	1	2	2	3	3	3	4	3	1	3	4	3	1	2	r	+	3	2
PTCR	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELT.	+	1	+	+	+	r	+	+	+	+	+	+	+	+	r	+	+	+	+	+	r	1	r	+	r	+	r	+	+	1

Species	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
SHCA	r	+	+	+	r	r	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	r
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	r	r	0	2	+	r	0	0	0	0	0	+	r	0	r	r	0	r	r	r	r	0	+	r	0	0	0	0
ROAC	r	r	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	0	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	r	r	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	r	r	r	+	0	r	0	0	0	0	r	r	r	r	+	+	r	r	r	r	r	+	r	1	+	+	+	r	r
LIBO	+	+	r	r	+	+	r	+	+	+	r	+	+	r	+	+	+	r	+	+	+	+	+	+	+	+	1	+	+	r
VACA	+	+	+	+	+	+	r	0	0	+	r	r	0	r	+	0	r	+	r	+	1	+	+	1	+	+	0	+	r	r
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	1	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	+	+	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0
ORSE	r	r	r	r	0	0	0	r	r	r	r	0	r	0	r	r	r	r	+	r	r	0	r	r	r	+	r	r	r	r
PYCH	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	r	r	r	r	0	r	r	0	0	r	r	r	0	0	0
COCA	1	1	+	+	+	+	+	+	+	1	+	+	+	+	+	r	r	+	r	+	+	+	+	+	+	0	0	0	r	0
ACMI	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	r	+	r	r	+	+	+	+	r	r	0	0	r	r	+	0	0	r	r	0	0	0	0	0	0	0	0
ASCI	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	r	r	r	r	+	0	0	r	r	r	r	r	0	0	0	0	r	r	r	r	r	r	0	0	0	0
SOSP	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	r	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	+	r	r	r	r	r	r	r	+	r	r	r	+	+	+	+	r	r	r	r	r	r	r	r	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	+	r	r	r	r	+	+	r	r	r	r	+	+	+	r	r	r	r	r	+	r	r	r	r	r	+	r	r	r	+
HYSP	1	2	3	2	2	1	3	5	5	6	4	1	+	+	1	4	+	+	1	1	1	1	1	+	+	+	1	2	1	3
PLSC	3	4	3	3	3	2	4	2	1	+	r	1	3	2	4	3	4	4	3	2	3	2	1	1	1	+	+	2	3	3
PTCR	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELT.	+	+	+	+	+	+	+	+	+	+	+	+	+	1	+	+	+	+	+	+	+	+	+	r	1	+	+	r	+	+

Table B-5. Continued (Whirlpool understorey 1967).

Species	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
SHCA	0	+	+	1	+	+	+	+	+	+	+	+	r	+	+	r	+	r	+	+	+	+	+	+	+	r	+	r	r	0
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
JUCO	0	0	1	r	0	0	0	0	0	+	r	r	+	0	+	r	r	r	1	0	0	1	r	+	r	0	0	+	r	r
ROAC	0	r	r	r	r	r	0	r	r	0	r	r	r	+	r	0	r	r	r	r	0	r	r	r	0	r	r	r	r	r
SALIX	0	0	0	r	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	r	r	+	+	r	r	r	r	r	0	r	1	r	r	r	r	+	r	0	0	+	r	r	r	r	r	0	0	0
LIBO	+	+	+	+	+	+	r	+	+	+	+	+	+	1	r	+	+	+	1	1	+	r	+	r	+	+	+	0	0	r
VACA	+	+	r	0	+	1	1	1	1	r	+	+	0	r	1	0	+	r	r	r	r	+	r	0	r	r	0	+	+	0
VAME	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	+	+	+	r	+	r	0	0	0	0	0	r	0	r	r	r	r	r	r	0	r	r	0	0	r	r	r	r	r	0
PYCH	r	0	r	r	r	r	r	r	r	r	r	0	0	r	r	r	0	r	0	0	0	0	r	0	r	r	r	r	r	0
COCA	0	0	0	r	r	+	+	+	+	+	r	0	+	0	r	r	0	r	+	1	+	r	+	r	+	+	+	0	0	r
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	r	0	0	0	0	0	r	r	0	r	r	0	r	r	+	r	+	+	0	0	r	r	r	r	r	+	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0
ASCO	0	0	0	0	0	0	r	r	r	r	0	r	0	r	0	+	r	r	0	0	0	r	0	r	r	r	r	0	0	+
SOSP	r	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0
EPAN	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	r	0	0	0	0	r	0	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r	r	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	+	r	+	+	r	r	r	r	r	r	+	+	+	+	r	r	r	r	r	r	r	r	r	r	+	r	r	+	+
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	r	r	r	r	r	r	r	+	r	+	r	r	r	r	+	+	r	r	r	r	r	r	r	r	r	r	r	0
HYSP	1	2	1	2	1	4	5	5	5	3	2	2	1	1	5	5	r	r	4	5	5	3	1	1	3	3	1	2	+	5
PLSC	3	3	3	3	3	2	+	r	1	3	2	2	2	3	1	1	4	3	2	1	1	4	2	3	3	3	3	3	3	2
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
PELT.	+	1	1	+	1	1	+	r	+	+	r	+	+	1	1	+	+	+	+	1	1	+	1	1	+	+	+	r	1	+

Species	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SHCA	0	+	+	r	+	+	+	+	+	+	r	+	+	+	+	r	0	r	+	0	r	+	+	+	+	+	+	+	+	r
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	0	0	0	r	+	0	0	0	0	r	0	0	0	0	+	0	0	0	0	0	0	0	1	0	r	0	+	0	r
ROAC	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r	r	r
SALIX	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	r	0	r	+	+	+	+	r	+	r	0	r	0.6	r	+	r	r	r	0	0	0	r	+	r	+	+	+	r	0	0
LIBO	r	+	+	+	1	+	+	1	0	0	+	+	r	+	+	+	1	+	+	+	1	1	+	+	1	+	+	1	+	+
VACA	r	+	r	r	+	1	+	+	r	r	+	+	1	+	r	1	+	+	+	+	r	+	+	r	0	0	0	r	r	r
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	+	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	r	0	0	r	0	0	0	0	0	r	0	r	r	0	r	0	r	r	r	r	r	r	r	r	0	0
PYCH	r	r	0	r	r	0	0	r	r	0	r	r	r	r	0	r	0	r	0	0	r	r	r	0	r	0	0	0	0	0
COCA	r	+	+	+	1	+	+	1	0	0	r	0	+	1	+	+	+	+	+	+	r	0	+	+	+	+	+	+	+	1
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	0	+	0	+	+	r	+	+	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0
ASCO	0	r	0	r	r	r	0	0	0	r	r	r	+	0	r	r	0	0	0	0	r	0	0	0	r	r	0	0	r	0
SOSP	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
EPAN	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GOOB	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	r	0	0	r	+	r	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	r	r	r	r	r	+	r	r	+	+	+	+	+	r	r	r	r	r	r	+	+	r	r	+	+	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	r	r	r	r	+	r	r	r	+	+	+	r	r	+	r	r	+	+	r	r	r	r	2	0	r	r	r	r	r
HYSP	5	4	4	4	3	+	3	3	2	r	+	1	2	1	r	4	2	2	4	5	4	2	1	+	+	3	4	5	6	6
PLSC	1	2	1	1	2	3	3	3	3	2	5	5	3	3	2	1	3	3	2	2	3	3	2	3	3	3	1	1	r	r
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+
PELT.	+	1	+	+	+	+	+	+	+	+	+	+	r	+	+	+	r	1	+	+	r	+	+	+	+	+	+	+	+	+

Table B-5. Continued (Whirlpool understorey 1967).

Species	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
SHCA	r	+	r	+	+	+	+	+	+	+	0	r	r	+	r	+	+	+	+	r	r	+	1	+	+	r	r	+	r	r
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	1	0	r	0	r	0	0	0	0	+	r	0	0	+	r	0	0	r	0	+	0	0	r
ROAC	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	r	r	0	+	r	r	0	0	0	r	r	+	+	+	1	+	r	+	+	r	+	+	+	r	r	r	+	0
LIBO	r	+	+	+	+	+	+	+	1	+	r	+	+	1	+	+	r	+	1	1	+	+	r	+	+	+	+	1	+	+
VACA	r	+	+	r	0	+	+	+	+	+	r	r	r	+	+	+	r	+	+	r	0	0	+	+	+	+	+	+	1	r
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0
ORSE	r	r	0	0	0	r	r	0	+	0	0	r	0	r	r	0	r	r	r	r	0	r	0	0	0	0	r	0	r	0
PYCH	0	0	0	0	0	0	0	r	r	0	0	0	r	0	0	r	r	0	0	0	r	r	r	r	r	0	r	r	0	0
COCA	1	1	+	r	r	+	r	r	+	1	1	1	+	+	+	1	+	r	0	r	0	0	r	+	1	+	+	+	+	1
ACMI	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
AMRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	+	+	0	r	r	+	+	r	r	r	+	+	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	r	+	r	r	0	0	r	0	0	0	r	r	r	0	r	0	r	0	r	0	r	r	r	r	r	r	0	0	0
SOSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	r	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	r	r	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	+	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	+	r	r	+	+	r	r	r	r	r	r	r	+	r	+	r	+	+	r	r	+	r	r	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	+	r	r	+	+	+	1	r	r	r	r	+	+	r	r	r	r	r	+	+	r	r	r	r	+	+	+	r
HYSP	6	6	5	6	6	4	+	1	1	5	6	5	3	1	r	r	+	+	r	r	1	r	1	2	1	1	+	2	2	3
PLSC	+	+	1	+	+	3	4	5	5	2	1	2	3	2	1	3	1	5	5	4	2	4	4	4	2	1	4	4	4	3
PTCR	1	+	1	+	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELT.	+	+	+	r	+	+	+	+	1	r	r	r	1	+	+	+	+	1	+	+	1	+	1	+	1	+	+	+	1	+

Species	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
SHCA	+	r	r	r	+	+	+	+	r	r	0	0	+	+	r	+	+	r	+	r	r	+	+	+	0	+	+	r	+	+
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	+	0	0	0	0	+	1	0	0	r	+	r	0	0	+	r	+	0	0	r	0	0	r	r	0	0	1	+	+	0
ROAC	r	0	r	r	r	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	0	r	r	0	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	r	r	0	+	+	+	r	r	0	0	0	0	r	0	r	r	r	r	r	r	r	r	r	r	r	+	+	+	r	0
LIBO	+	1	+	+	+	1	1	+	r	+	1	r	r	r	r	1	+	+	+	1	+	r	r	1	+	+	1	+	2	+
VACA	r	r	+	r	+	0	r	r	r	r	0	r	r	r	r	0	r	+	r	+	0	r	+	+	+	+	r	+	1	+
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	r	0	0	0	0	r
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	+	+	0
ORSE	0	+	r	r	0	r	r	0	0	0	r	0	0	r	r	r	0	r	r	0	0	r	0	r	0	0	+	r	r	r
PYCH	0	r	0	0	0	0	0	0	0	r	0	r	r	r	0	r	0	r	r	r	0	0	r	0	0	r	r	r	r	r
COCA	+	+	1	+	+	+	r	+	+	+	1	2	+	+	+	+	1	+	+	+	r	+	+	+	+	+	r	0	0	0
ACMI	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
AMRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	+	r	r	r	r	+	r	+	+	+	0	r	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	+	r	0	0	0	r	+	0	0	0	0	r	0	0	0	+	0	r	r	0	r	r	0	r	r	r	r	r
SOSP	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	r	0	r	0	+	+	0	r	0	0	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	r	r	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	r	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0
ELIN	+	+	r	+	r	r	r	+	r	r	r	r	+	r	r	r	+	+	+	+	r	r	r	r	r	+	r	+	+	+
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
DIPO	+	+	r	r	r	+	1	+	r	r	r	+	+	+	+	+	r	+	+	1	+	+	r	+	+	+	+	r	r	+
HYSP	2	3	4	2	3	1	2	2	5	5	6	5	4	4	4	3	3	3	2	1	2	5	4	+	+	+	r	r	+	1
PLSC	4	3	3	5	3	3	3	2	1	1	+	1	3	4	3	1	2	4	4	2	5	3	2	2	1	3	3	3	2	2
PTCR	0	0	0	0	0	0	0	0	0	+	r	1	1	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELT.	1	+	r	r	+	+	+	r	+	+	+	+	1	+	1	+	+	+	+	1	+	+	+	+	+	+	+	+	+	1

Table B-5. Continued (Whirlpool understorey 1967).

Species	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
SWCA	+	+	+	+	+	+	+	+	+	+	+	+	r	+	+	+	r	+	0	0	r	0	0	+	+	+	r	+	+	+
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
JUCO	1	2	0	+	r	0	0	r	0	0	r	+	r	+	+	0	0	0	r	r	r	0	0	0	0	r	r	0	2	1
ROAC	r	r	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	0	r	0	r	r	r	r	r	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	r	+	r	r	r	r	0	0	+	r	r	r	r	r	0	0	0	0	0	0	0	0	0	r	r	r	r	1
LIBO	1	+	r	+	+	+	r	r	r	+	+	r	1	r	r	r	r	+	1	+	+	r	r	r	+	+	+	+	+	+
VACA	+	1	+	+	+	+	1	+	+	r	0	0	0	0	+	r	+	r	r	r	0	0	+	+	0	0	+	0	0	0
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	r	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	+	+	r	r	r	0	0	0	r	r	r	r	r	0	0	r	0	0	r	r	0	+	r	r	0	0	0	r	r	r
PYCH	r	0	r	r	0	r	r	r	r	r	r	r	0	0	r	0	r	0	r	0	0	0	0	0	0	r	r	0	0	0
COCA	0	r	+	+	+	+	+	+	0	0	+	+	+	+	+	+	1	+	1	1	+	1	1	1	+	+	+	+	+	r
ACMI	0	0	r	0	r	0	0	0	0	0	0	0	0	0	r	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0	r	0	0	+	r	r	r	r	0	0	0	0
ASCI	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	r	0	0	r	r	r	r	r	r	r	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	r	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	r	r	r	r	r	r	r	r	r	+	r	r	r	+	r	r	r	+	+	+	+	r	r	r	r	r	r	r	+
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	+	r	r	+	+	+	r	r	+	+	+	+	+	+	+	+	+	+	r	r	0	0	r	+	+	+	+	r	r
HYSP	+	1	+	+	3	2	1	3	4	4	1	+	1	4	2	3	4	5	6	6	6	5	5	4	3	2	2	3	1	1
PLSC	1	2	1	2	2	3	3	3	2	4	2	4	4	3	3	3	3	1	+	1	r	+	r	r	2	2	2	3	4	3
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	r	r	1	r	+	2	0	0	0	0	0	0	0
PELT.	+	+	+	+	r	+	+	+	+	+	1	+	+	+	1	+	+	+	r	+	+	+	+	+	+	+	+	+	r	r

Species	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SWCA	r	+	+	+	+	+	+	+	r	+	r	r	r	r	+	+	r	+	+	r	r	+	+	+	r	0	r	r	0	0
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
AMAL	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	r	r	0	0	0	r	r	r	r	r	0	0	0	0	0
JUCO	0	0	0	0	+	+	r	r	0	0	0	0	r	r	r	r	r	0	0	1	1	1	0	0	r	0	0	0	0	0
ROAC	r	r	r	r	r	0	0	0	0	0	0	0	r	0	r	r	r	r	r	r	r	r	r	r	r	r	0	r	r	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	r	r	+	+	r	0	0	+	r	0	0	r	r	r	0	r	r	+	r	r	0	r	r	0	0	0	0
LIBO	+	+	1	+	2	1	+	+	r	+	+	+	+	+	+	+	+	+	+	1	1	+	+	+	r	+	r	r	r	+
VACA	r	r	+	0	+	+	0	1	+	0	+	+	r	r	0	r	+	r	r	0	0	r	0	r	+	+	+	+	0	r
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	r	0	r	0	r	r	0	r	0	+	r	0	0	r	r	r	0	r	r	r	r	r	r	0	0	r	r	r	r
PYCH	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	0	0	r	r	r	0	0	0	r
COCA	+	+	+	+	+	+	r	+	+	0	+	r	r	0	r	r	+	+	0	0	0	r	+	+	+	+	1	1	1	1
ACMI	0	0	0	0	0	0	r	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	r	r	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	r	r	0	0	r	r	r	r	r	r	r	0	0	r	r	r	r	r	r	0	0	0	0	0	r	0	0	0	0
SOSP	0	0	0	0	0	r	+	r	0	0	0	0	r	+	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	r	0	0	r	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	r	+	r	+	r	r	+	r	r	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	+	+
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	+	r	r	r	r	r	r	+	+	+	+	+	+	r	r	+	r	+	+	1	r	+	+	r	r	r	0	r	r
HYSP	3	4	3	2	1	1	+	+	1	r	r	r	+	+	1	1	+	2	2	1	2	2	2	1	3	5	6	5	6	6
PLSC	3	2	3	2	+	3	3	2	1	2	1	1	1	2	2	2	2	2	2	2	1	2	2	2	2	1	r	r	r	+
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	+	r
PELT.	+	+	+	+	r	r	+	r	+	r	+	r	+	+	r	+	+	+	+	+	+	+	r	+	+	+	r	+	+	+

Table B-5. Continued (Whirlpool understorey 1967).

Species	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
SHCA	r	r	0	0	r	r	r	+	r	+	+	r	+	r	r	r	r	r	r	r	+	+	r	r	+	+	+	r	+	+
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r
JUCO	0	0	0	0	2	+	0	0	1	0	r	0	r	+	2	r	0	0	0	0	0	r	1	1	r	r	1	0	2	+
ROAC	r	0	0	r	r	r	r	r	r	r	0	0	0	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	0	r	0	0	r	r	+	+	r	0	r	r	1	+	+	1	+	r	+	+	r	+	r	r	r	1	+
LIBO	r	r	+	r	+	r	+	1	+	+	+	+	r	+	1	+	+	+	+	+	r	+	+	+	2	+	+	1	+	1
VACA	r	r	r	r	r	+	+	+	r	0	+	r	+	r	1	+	+	0	+	0	r	+	r	+	1	2	+	r	r	+
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	r	r	0	0	r	+	r	0	r	r	r	r	r	0	r	r	r	r	r	0	0	0	0	r	r	r	+	r
PYCH	0	0	0	0	0	r	0	r	0	0	r	0	r	r	r	r	r	0	r	r	r	r	r	0	0	0	0	0	0	0
COCA	1	+	1	1	1	1	+	+	r	r	r	0	0	0	r	r	+	r	+	+	r	r	r	+	r	0	0	r	0	r
ACMI	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	r	0	0	0	+	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
ASCO	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	r	0	r	r	r	r	r	r	0	0	0	0	r	0	0
SOSP	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	r	r
GELI	0	r	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	r	0	0	0	r	r	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0
EPAN	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	r	0	0	r	0	0	r	r	0	0	0	0	0	0	r	0	r	0	r	r	0	0	r
COTR	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	+	r	r	r	r	r	+	+	r	+	r	r	r	r	r	r	r	r	r	+	+	r	r	r	r	r	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	r	+	r	r	+	+	+	r	r	+	r	r	r	+	r	+	r	r	1	1	r	+	r	+	r	+	+	1
HYSP	5	6	6	5	5	5	2	2	4	1	2	r	2	1	+	1	3	r	r	1	r	r	2	3	1	+	3	1	1	r
PLSC	1	+	1	r	+	+	2	2	3	2	1	2	3	3	3	3	3	1	+	2	1	2	2	2	1	2	1	2	+	+
PTCR	1	0	0	2	+	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELT.	+	+	+	+	+	+	+	+	+	+	r	r	r	+	r	r	+	+	+	+	+	+	+	r	+	+	r	+	r	r

Species	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
SHCA	+	+	+	r	r	0	0	r	0	r	r	0	0	0	0	0	r	+	r	+	+	+	+	+	+	+	r	+	+	r
LEGR	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	0	0	0	0	0	0	r	r
JUCO	r	+	0	r	0	+	0	0	0	r	0	0	0	0	+	+	+	+	2	+	r	0	0	r	0	0	r	+	0	r
ROAC	r	r	r	r	r	r	0	0	0	0	r	0	r	0	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	r	r	r	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	1	r	+	+	+	r	r	+	+	r	r	r
LIBO	+	+	+	+	+	1	+	r	r	+	r	+	+	r	+	1	+	1	1	1	+	+	1	r	+	1	+	+	+	+
VACA	r	r	r	r	r	r	r	r	r	r	r	+	r	r	+	r	r	+	+	+	r	0	1	r	+	+	+	+	+	r
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUPU	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	r	r	0	0	0	0	0	0	0	0	0	r	r	r	0	r	0	r	r	r	+	r	r	r	0	0	0	r	+
PYCH	r	0	0	r	0	0	0	0	0	0	r	0	0	0	0	r	0	r	r	0	0	r	r	0	0	r	0	r	0	r
COCA	+	r	+	+	+	1	+	r	+	+	+	+	+	+	1	1	+	r	r	+	r	0	r	r	+	r	r	r	+	r
ACMI	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	+	+	r	r	r	0	0	0	0	0	0	0	0	r	r	r	r	r	0	r	r	r	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	r	r	r	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	+	0	0	0	0	0	0	r	r	r	r
SOSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GELI	r	0	0	0	0	r	r	r	+	0	r	+	0	r	r	0	0	0	r	+	0	0	r	r	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	r	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	r	0	0	r	0	r	r	0	r	r
COTR	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	r	+	r	r	r	r	+	+	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	+	r	+	r	r	r	r	r	r	+	r	r	r	r	0	r	+	+	+	+	+	+	+	+	+	r	+	+	+	+
HYSP	r	1	1	2	5	5	4	6	5	5	6	5	6	6	5	3	4	1	r	+	+	r	r	4	2	+	1	+	r	r
PLSC	+	1	2	1	1	r	1	r	r	1	1	+	r	1	r	r	+	1	r	+	+	1	+	2	2	+	+	1	1	1
PTCR	0	0	0	0	0	0	+	1	0	+	r	1	r	r	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELT.	+	r	+	+	r	+	r	+	1	+	+	+	r	1	+	r	r	+	+	+	+	+	+	+	+	r	+	+	+	+

Table B-5. Continued (Whirlpool understorey 1967).

Species	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
SHCA	r	r	+	+	+	r	+	+	+	r	+	+	+	+	r	0	0	0	0	0	0	0	0	0	0	0	+	+	+	+
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	0	0	0	0	0	0	+
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	r	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	r	1	2	1	r	r	r	+	0	r	r	r	0	0	0	1	0	r	0	+	0	0	r	0	0	r	0	+	0	0
ROAC	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	0	0	r	r	r	r	0	r	r	r	0	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	+	0	r	+	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0
ARUV	+	+	+	1	r	+	1	1	1	1	+	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	+	+
LIBO	1	r	+	1	1	+	1	1	2	2	1	1	1	r	r	r	r	r	+	+	+	r	r	0	r	r	r	1	+	r
VACA	r	r	+	+	+	+	r	+	+	r	1	+	r	0	+	r	0	r	+	r	0	0	r	r	r	0	r	0	0	+
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
ORSE	r	r	r	0	0	0	r	r	r	r	r	r	0	r	0	r	r	0	r	0	r	0	0	0	r	r	r	r	r	r
PYCH	r	r	r	r	r	r	r	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	r	r
COCA	+	+	+	r	r	r	r	r	r	+	+	+	r	+	+	1	+	1	1	1	+	+	+	+	+	+	+	r	r	+
ACMI	0	r	r	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	+	0	r	r	0	0	0	0	0	0	0	0	0	r	r	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	r	r	r	0	r	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r
SOSP	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	r	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	r	0	r	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	r	0	r	0	0	r	0	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	+	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	r	1	+	+	r	r	r	+	+	+	+	+	r	r	r	0	0	0	0	0	r	0	0	r	+	+	+	1
HYSP	3	1	+	r	r	+	1	1	2	1	+	1	1	3	5	6	5	6	4	5	5	6	5	5	6	4	2	1	r	+
PLSC	2	2	2	1	r	+	1	1	1	1	1	1	1	+	+	r	1	r	r	+	1	+	2	2	1	+	3	4	3	1
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	+	+	+	+	0	0	0	0	0	0	0	0	0	0
PELT.	+	r	+	+	+	+	1	+	+	+	+	+	+	+	+	+	r	+	+	+	r	r	+	+	+	r	+	+	+	+

Species	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
SHCA	+	1	+	r	+	+	+	+	+	r	+	+	+	+	+	r	r	+	+	+	r	r	+	+	+	r	0	0	0	r
LEGR	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	r	r	0	0	0
AMAL	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
SPBE	r	r	r	r	0	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	1	+	2	r	0	0	0	0	0	0	+	r	r	+	r	0	0	+	0	r	+	1	+	0	0	0	0	0
ROAC	r	r	r	r	r	r	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	0	0	r
SALIX	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	1	2	+	r	1	1	+	+	r	0	r	r	r	1	+	+	+	+	r	r	r	r	r	0	0	0	0	0	0
LIBO	1	+	1	1	2	2	+	+	+	1	1	+	+	1	1	1	+	+	1	1	+	+	1	+	r	r	r	r	r	+
VACA	0	r	1	0	2	+	+	0	r	r	1	r	+	r	r	2	2	2	0	1	1	+	1	1	+	r	r	r	r	+
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0	0	0	0	0	0
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	r	0	0	r	0	0	0	0	0	r	0	r	r	0	0	0	0	0	r	+	0	0	r	0	0	0	0	0	0	0
ORSE	0	r	0	0	0	0	r	r	0	r	0	0	0	0	r	0	r	r	+	r	r	0	r	r	0	0	0	0	0	0
PYCH	r	0	0	r	0	0	r	r	0	r	r	r	r	0	r	r	r	0	r	r	r	0	r	r	r	r	r	0	0	0
COCA	+	+	r	0	+	r	r	+	r	r	+	+	r	0	0	0	0	r	r	+	1	+	+	+	+	+	+	+	+	+
ACMI	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	r	r	0	0	0	0	r
ASCI	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
ASCO	r	0	r	0	0	0	r	r	r	r	r	r	0	r	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0
SOSP	0	r	0	0	0	0	r	r	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	+
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	r	r	0	0	0	r	0	0	r	0	0	r	r	0	0	0	0	r	r	r	0	r	0	0	0	r
EPAN	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	r	r	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	r	0	r	0	0	0	0	0	0	0	0	0	r	r	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	+	r	r	r	r	r	r	r	+	r	r	r	r	+	r	+	+	+	r	r	r	r	r	r	r	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	+	r	r	r	+	+	r	+	r	+	r	r	+	+	r	+	r	r	r	r	+	r	r	r	0	0	0	r	r	0
HYSP	1	+	+	+	+	r	+	1	r	+	2	1	1	+	2	1	2	+	1	1	2	3	1	4	6	6	6	6	6	6
PLSC	1	+	+	+	+	+	2	2	2	2	2	2	2	+	2	2	3	2	2	2	2	4	2	1	1	1	+	1	+	r
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELT.	r	r	r	+	r	+	+	+	r	1	r	+	+	r	r	+	+	+	r	+	+	r	+	+	+	+	+	1	1	+

Table B-5. Continued (Whirlpool understorey 1967).

Species	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
SHCA	0	0	r	r	r	+	r	+	r	+	1	1	r	+	+	r	+	r	+	+	+	+	+	r	+	+	r	+	+	+
LEGR	0	0	+	1	+	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AMAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	r	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	r	r	r	r	r	r	r	r	r	r	r	0	r	r	r	0	0	r	r	r	r
JUCO	0	0	0	0	0	r	0	+	r	0	2	0	0	r	+	r	r	0	0	0	0	0	r	0	+	r	0	r	0	0
ROAC	0	0	0	r	0	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	0	0	r	r	+	r	0	+	+	2	1	+	1	1	+	r	+	r	r	+	1	+	+	+	r	r	+
LIBO	+	r	r	r	+	+	2	1	1	1	1	1	1	+	+	1	+	+	r	+	+	+	+	+	+	+	+	+	1	+
VACA	r	0	r	r	+	0	r	1	+	0	r	0	r	+	+	1	1	+	+	1	+	0	r	1	1	1	+	1	1	r
VAME	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	r	r	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r
RUPU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	+	0	0	0	0	0	0	r	0	0	r	r
ORSE	0	0	0	0	0	r	0	0	0	r	r	r	r	0	r	r	r	0	0	r	0	0	0	r	r	0	0	0	r	r
PYCH	r	0	r	0	r	r	r	0	r	r	0	0	0	r	0	r	r	r	r	r	r	r	r	0	0	0	0	0	0	r
COCA	2	1	+	1	1	+	+	1	+	+	r	r	0	0	0	0	r	+	+	+	+	r	r	0	r	+	r	+	r	+
ACMI	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	r	r	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r
ASCI	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	r	r	0	0	r	r	r	r	r	0	r	r	0	r	r
SOSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	r	r	0	0	0	r	0	0
EPAN	r	r	r	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
LAOC	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	r	r	0	r	r	0	0	r	r	0	r	0	r	0	0	0	r	r	0	0	0	r
COTR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0	r	0	0	r	r	0	r	r	0	0	0	0	0	r	r
HAOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	r	r	r	r	r	+	+	r	r	r	r	r	+	+	+	r	r	+	+	r	r	r	r	r	+	r	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	0	0	r	0	r	+	+	+	+	+	+	r	r	r	r	r	r	+	r	+	r	r	r	r	r	+	r	r
HYSP	6	6	6	5	4	4	2	1	r	r	+	r	r	1	r	1	2	3	4	3	3	5	3	1	+	2	1	1	1	+
PLSC	1	r	+	1	3	+	2	1	1	1	2	1	1	2	1	1	2	2	1	2	1	1	1	3	+	2	2	1	2	1
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PELT.	+	+	+	+	1	+	1	+	+	+	1	1	+	1	1	r	r	+	r	r	+	1	+	+	1	+	+	1	+	+

Species	391	392	393	394	395	396	397	398	399	400
SHCA	1	r	+	0	r	r	r	0	0	0
LEGR	0	0	0	0	0	0	+	+	0	0
AMAL	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	r	0	0	0	0	0	0	0
JUCO	2	+	0	0	r	0	0	r	0	0
ROAC	r	r	r	r	r	r	r	r	r	0
SALIX	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0
ARUV	r	+	r	0	0	0	r	0	0	0
LIBO	+	1	+	+	+	+	+	+	r	r
VACA	+	r	+	0	0	r	+	r	r	r
VAME	0	0	0	0	0	0	0	0	0	0
VASC	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	0
RUPU	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0
ORSE	0	r	0	0	+	0	0	0	0	0
PYCH	r	r	0	0	r	r	0	r	0	0
COCA	1	+	1	1	1	+	1	2	1	+
ACMI	0	0	0	0	r	0	r	0	0	0
ANRO	0	0	0	0	0	0	0	0	0	0
ARCO	0	r	r	r	0	0	r	0	r	r
ASCI	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	r	0	r	0	0	0
SOSP	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	r	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	r	r	r	r
EPAN	r	r	r	r	r	r	r	r	0	r
LAOC	0	0	0	0	r	0	r	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0
CABU	0	0	r	0	0	0	0	0	0	0
COTR	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0
HAOB	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	r	0	0
ELIN	r	r	r	r	r	r	r	r	r	r
TRSP	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0
DIPO	r	+	+	r	r	r	r	0	r	0
HYSP	1	+	4	6	5	4	6	6	6	6
PLSC	4	2	+	+	+	1	+	+	+	r
PTCR	0	0	0	0	0	0	0	0	0	0
PELT.	1	1	1	+	1	2	r	r	r	r

Table B-6. Understorey species cover estimates for Whirlpool 1989.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SHCA	+	0	3	13	5	2	5	11	4	2	11	25	16	13	9	6	4	7	15	2	4	5	0	4	4	5	4	7	7	7
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	+	r	r	2	0	0	r	0	r	r	+	+	r	r	0	0	r	0	0	0	2	15	4	3	2	0	0
ROAC	r	r	+	+	+	0	r	+	r	+	r	+	+	2	0	0	+	+	2	2	+	+	2	0	r	+	2	2	2	+
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	0	0	+	0	0	0	+	0	0	4	7	+	4	0	0	0	0	0	4	0	0	8	9	0	3	0	2
LIBO	+	+	+	+	6	+	3	4	4	+	2	4	2	13	4	6	7	7	9	5	7	9	6	9	6	4	3	5	5	5
VACA	+	0	r	+	2	+	2	3	2	2	7	6	2	17	7	3	8	6	8	4	7	7	6	4	+	10	28	8	5	7
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	r	2	2	0	2	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0
ORSE	r	r	r	0	r	0	r	+	r	r	0	0	0	0	r	+	+	r	0	0	r	r	0	r	r	+	0	r	r	r
PYCH	0	0	0	0	0	0	0	r	r	0	r	0	r	r	r	r	r	0	0	r	0	0	r	r	r	0	0	0	0	0
COCA	12	12	11	10	6	7	6	8	8	8	10	10	4	3	3	2	0	0	0	0	0	0	+	+	2	4	6	6	6	7
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	2	r	2	3	+	2	2	2	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	2
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	+	r	0	0	0	+	+	0	0	+	r	0	+	r	+	+	+	0	0	0	0	0	0	2	2	2	r	0	0	0
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	r	0	0	0	0	0	r
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	6	5	6	5	4	5	5	4	4	6	5	7	6	5	5	5	6	5	4	6	6	4	5	4	4	4	5	4	5
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	r	+	+	r	r	5	0	r	r	r	+	0	0	r	r	0	0	r	r	0	r	0	r	2	+	+	r	+
DIUN	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	75	70	65	63	28	38	32	22	28	35	39	15	18	38	59	27	45	68	30	73	75	39	30	32	5	5	8	27	13	35
PLSC	r	r	2	12	25	22	35	36	36	28	27	18	15	14	11	15	8	r	15	8	+	9	19	0	21	27	12	15	24	26
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	0	0	0	r	0	6	0	0	r	r	r	0	r	r	+	+	0	0	r	0	0	0	0	+	r	r	3	2	+	r
CLADONIA	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	r	0
PELT.	11	8	6	5	4	3	5	3	3	4	2	3	4	3	5	3	2	3	5	3	2	6	+	5	3	4	6	4	3	2
STEREO.	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
SHCA	2	4	6	12	4	4	6	3	6	2	2	6	10	7	8	6	8	8	4	15	4	9	11	5	13	11	10	3	7	4
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	r	2	0	6	8	r	0	0	0	0	r	2	2	0	5	2	0	2	2	r	5	r	4	+	3	0	0	r
ROAC	2	r	r	0	+	2	2	+	+	2	+	r	r	+	+	+	2	2	2	3	2	+	0	r	0	+	r	2	3	2
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	7	+	2	+	9	7	3	0	0	0	0	0	0	5	4	4	9	5	0	3	4	7	6	7	6	14	5	0	6	+
LIBO	5	3	r	5	3	8	2	3	5	5	3	5	5	3	3	6	3	5	3	4	5	7	6	6	7	15	11	7	5	4
VACA	5	7	4	5	4	+	2	0	2	9	5	+	2	+	0	0	6	8	6	4	11	10	8	23	6	8	5	5	0	r
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	0	+	0	0	r	0	0	r	0	0	r	0	0	0	0	0	0	0	2	2	0
CHUM	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0
ORSE	r	+	r	+	0	r	r	0	0	r	r	r	0	0	+	r	+	+	2	2	r	0	0	r	r	+	2	r	r	r
PYCH	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	r	r	0	0	0	0	0	0	r	r	0	0
COCA	9	7	7	6	7	5	6	9	8	8	8	7	9	5	5	5	3	5	4	5	5	6	9	10	3	+	2	0	0	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	r	0	4	2	+	+	2	2	+	3	3	4	0	r	2	+	3	0	0	+	+	0	0	0	0	0	0	0	0
ASCI	0	0	r	2	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	+	2	r	2	+	r	0	+	0	0	2	r	0	0	0	r	0	r	+	r	+	+	0	0	0	0
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0
VIAD	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0
GOOB	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0	r	0	0	0	r	0	0	0	0	0	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	3	5	5	5	6	4	4	5	5	6	5	5	4	4	5	6	6	5	5	5	5	4	4	5	4	4	5	4	4	4
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	0	r	r	0	r	0	0	0	0	0	0	r	0	0	0	0	r	r	r	0	r	r	r	3	r	0	4	3
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
HYSP	35	29	52	50	24	15	27	58	63	55	58	56	21	6	25	37	28	21	15	22	35	49	25	20	31	32	45	43	36	22
PLSC	2	20	23	3	19	33	27	9	0	0	0	4	10	21	25	30	11	26	23	15	22	15	16	6	8	3	3	18	22	10
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	9	8	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	r	r	0	r	r	r	r	0	0	0	0	r	2	2	r	0	r	r	r	r	r	r	0	r	r	+	+	0	+	r
CLADONIA	0	0	0	r	r	0	r	0	0	0	0	0	0	r	0	0	0	0	0	r	+	r	0	0	r	r	r	r	r	r
PELT.	4	5	3	7	5	4	4	2	3	8	4	5	8	5	5	4	3	6	3	4	6	7	3	6	2	6	6	4	5	4
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0

Table B-6. Continued (Whirlpool understorey 1989).

Species	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
SHCA	3	4	3	17	10	5	4	10	5	5	4	13	+	4	4	3	13	3	5	3	4	7	7	5	11	+	12	4	4	2
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	+	r	r	0	0
JUCO	0	0	6	+	+	0	0	r	r	2	+	0	15	3	2	r	2	4	6	+	r	6	+	2	0	0	8	3	2	+
ROAC	2	+	2	+	+	0	0	r	0	+	2	r	2	3	+	r	+	2	2	0	r	+	+	+	r	+	2	2	2	r
SALIX	0	0	0	r	0	r	0	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	8	9	2	6	6	4	3	4	4	r	0	+	5	r	0	+	2	3	0	0	0	0	3	3	0	0	+	+	0	0
LIBO	6	4	2	2	6	6	4	5	4	3	6	3	+	+	4	4	3	6	4	5	4	3	15	7	2	3	6	3	5	4
VACA	3	7	r	4	9	7	8	8	8	5	6	5	2	5	6	0	3	0	3	0	0	3	2	r	0	2	0	3	8	0
VASC	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	0	0	0	0	0	0
CHUM	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r
ORSE	+	r	r	r	+	r	0	0	0	r	0	+	r	+	r	0	r	+	r	0	r	r	+	r	0	+	+	0	0	0
PYCH	0	0	r	r	r	r	r	r	0	r	r	r	0	r	0	0	0	r	0	0	0	0	0	0	0	r	0	r	0	0
COCA	0	0	2	4	7	6	8	5	8	7	3	2	2	+	3	2	4	5	6	10	5	4	12	2	4	5	4	4	3	2
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	2	3	0	4	2	0	2	+	5	0	6	2	0	0	r	2	5	4	2	2	2
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	r	+	0	r	+	r	+	2	0	0	0	+	2	2	r	0	0	0	0	+	0	r	+	+	+	0	0	+
SOSP.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	0	r	+	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0
GOOB	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	5	3	6	6	5	5	5	5	4	5	5	4	5	4	3	3	4	4	4	3	3	6	4	5	4	4	5	6	3
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	3	2	0	+	r	0	0	0	r	r	r	0	r	2	0	r	r	r	0	0	0	+	0	0	0	0	0	+	2	0
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
HYSP	33	43	59	38	55	53	71	78	74	33	42	32	21	12	70	41	23	35	52	72	70	41	41	33	22	32	35	30	19	64
PLSC	8	19	8	11	+	19	r	0	0	4	21	20	27	39	0	6	15	3	2	2	3	0	0	14	33	25	16	18	22	6
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	2	2	4	r	r	r	0	0	r	r	+	0	r	+	0	r	+	+	0	0	0	0	r	+	0	r	0	+	+	r
CLADONIA	r	+	0	r	r	r	0	0	r	r	0	r	r	r	0	r	r	r	r	0	0	r	0	r	r	0	r	r	0	r
PELT.	6	7	7	3	4	5	3	+	4	6	4	4	5	2	7	3	5	6	2	2	3	4	7	6	4	3	5	4	3	+
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SHCA	3	6	2	3	15	8	12	13	16	6	r	10	14	13	16	3	0	+	4	r	2	9	5	3	17	4	10	11	8	r
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	r	0	r	0	r	+	r	r	r	0	0	0	+	+	0	0	+	0	0	r	2	13	r	r	+	+	r	0
ROAC	+	2	+	2	+	+	+	r	+	r	0	5	r	r	r	r	+	r	+	+	+	+	+	+	r	r	0	+	r	+
SALIX	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	r	0	+	3	+	0	2	3	9	6	+	2	0	+	8	5	2	0	0	0	0	0	+	+	0	0	r	2	0	0
LIBO	4	4	3	6	2	3	4	+	4	2	3	3	2	4	3	6	6	4	3	2	2	2	+	2	5	5	4	5	2	2
VACA	2	2	3	4	5	9	3	5	0	r	+	2	8	7	3	8	4	3	2	+	+	2	2	0	0	0	r	2	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
CHUM	0	0	0	0	0	0	r	r	0	0	r	0	0	r	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
ORSE	0	0	r	0	r	0	0	r	0	0	0	r	r	r	0	r	r	r	0	0	r	+	0	+	r	r	0	0	0	0
PYCH	0	0	0	r	r	0	0	0	0	0	r	r	0	0	r	0	r	r	0	0	r	r	r	0	0	0	0	r	0	0
COCA	5	6	5	7	5	7	6	5	2	r	0	r	6	10	9	5	6	5	4	6	3	+	2	3	3	4	3	5	7	9
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	r	2	+	2	+	3	0	5	0	4	+	2	0	4	+
ASCI	0	0	0	0	0	0	r	0	0	0	0	0	+	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	+	r	+	r	0	r	0	r	r	0	+	r	+	+	r	0	r	0	+	0	0	0	0	r	r	+	0	0
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	+	2	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	r	r	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	r	0	0	r	0	0	r	r	0	r	r	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	3	3	5	3	5	5	4	6	5	5	5	5	4	5	4	5	4	3	3	3	6	4	5	3	5	3	4	3	5
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	2	0	0	r	+	r	r	2	+	r	r	+	0	+	r	0	0	r	r	+	+	+	0	0	0	r	0
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	63	53	63	45	46	26	31	35	15	8	21	23	42	48	26	58	39	45	65	68	52	29	12	21	39	74	82	73	71	81
PLSC	0	+	2	3	13	20	8	12	14	35	15	18	3	0	21	+	8	11	+	3	23	15	32	12	6	3	0	0	0	0
POJU	0	0	0	0	0	+	r	r	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	0	0	0	0	r	r	r	+	+	2	2	+	r	r	r	r	0	r	0	0	0	r	+	0	0	0	0	r	0	0
CLADONIA	r	0	0	r	r	r	r	r	r	r	r	r	r	0	r	r	0	r	0	r	0	0	r	0	0	0	0	0	r	0
PELT.	2	+	4	3	+	5	+	3	5	5	4	+	3	4	+	3	4	4	2	+	3	2	5	4	3	2	3	6	3	3
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0

Table B-6. Continued (Whirlpool understorey 1989).

Species	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
SHCA	0	8	5	4	+	15	3	4	9	4	0	+	3	10	3	9	22	20	2	4	2	10	17	16	12	3	3	2	+	2
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	6	0	2	+	+	0	0	r	0	2	4	r	r	0	5	+	0	0	2	2	2	0	0	0
ROAC	2	+	+	+	0	r	r	+	r	+	+	+	2	r	+	0	r	+	+	+	r	0	+	+	+	r	+	+	+	+
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	0	0	2	3	2	r	0	0	0	0	6	10	8	7	3	5	5	7	4	8	7	4	5	3	+	0	0
LIBO	2	r	2	5	+	2	4	5	3	+	+	2	7	3	+	3	4	4	4	5	+	5	7	3	3	8	5	4	+	3
VACA	0	r	2	r	0	r	+	+	2	4	r	2	2	2	5	3	3	2	2	2	r	2	6	5	7	6	3	+	2	r
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	+	+	0	0	0	0	0	r	0	0	0	0	0	0	0	0	+	+	0	0	0	0
ORSE	+	r	0	r	0	+	+	r	2	r	0	r	0	+	+	0	0	0	r	+	0	0	r	0	0	0	r	+	+	+
PTCH	0	0	0	0	0	r	0	r	0	r	0	0	0	r	r	r	r	0	0	0	0	0	r	r	0	0	0	0	0	0
COCA	12	8	4	3	2	3	2	3	4	3	7	4	3	9	15	13	8	3	0	2	0	0	2	5	9	8	5	4	4	4
ACMI	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	2	2	0	+	2	5	5	+	r	+	+	2	r	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	+	2	r	r	0	0	r	0	0	0	+	r	2	2	0	0	r	0	+	r	0	r	r	r	r	+	r	0	0
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	+	0	0	0	r	r	0	0	+	r	0	0	0	0	0	0	0	0	r	0	r	2	2	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	r	0	r	0	r	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	3	0	3	3	r	4	5	5	6	3	3	3	3	4	5	5	4	5	5	5	6	5	5	5	5	4	4	3	5	4
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	r	0	+	0	r	0	0	0	r	7	0	+	r	+	r	2	3	4	2	2	+	2	r	r	+
DIUN	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	72	71	61	79	72	46	35	45	42	69	82	55	24	28	20	27	16	39	5	6	15	22	15	28	30	30	25	63	64	73
PLSC	0	r	2	0	0	23	23	21	24	5	0	0	15	5	15	4	3	6	35	21	14	27	6	26	8	8	15	6	0	2
POJU	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	0	0	r	0	0	r	0	r	r	r	0	r	+	r	r	+	r	3	+	r	r	r	2	r	r	r	+	r	r	0
CLADONIA	0	0	r	0	0	0	r	r	r	r	0	0	r	r	r	r	0	+	r	r	0	0	r	r	r	r	r	0	r	0
PELT.	3	4	5	3	2	7	4	4	7	3	r	4	8	4	3	4	5	3	6	8	3	3	5	3	5	7	3	2	3	+
STEREO.	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
SHCA	3	0	0	2	8	6	3	6	4	0	0	r	9	4	3	16	2	3	8	+	+	+	4	9	+	3	16	4	10	8
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	4	+	0	0	0	3	+	+	0	0	3	2	+	+	3	+	+	0	0	+	0	0	+	+	0	r	3	4	3	r
ROAC	+	r	r	+	r	r	r	r	r	2	+	0	0	+	+	+	r	+	+	+	+	r	+	r	r	0	0	r	+	+
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	2	3	+	0	0	0	0	0	0	0	0	0	0	0	0	2	r	0	0	0	3	0	5	6	3	0	+
LIBO	+	+	+	2	5	2	4	3	+	3	0	+	+	+	2	4	+	+	2	2	4	2	2	4	5	2	5	3	5	3
VACA	r	r	r	+	r	0	0	2	r	3	+	+	2	r	r	r	2	r	0	+	0	2	3	8	8	3	3	7	10	4
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	r
PRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	0	0	0	0	0	0	0	0	+	0	0	0	0	+
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0
ORSE	r	+	r	r	r	0	r	0	0	0	r	r	0	0	r	+	0	r	r	0	0	r	r	0	0	0	r	+	r	r
PTCH	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	r	0	r	r	0	0	0	0	0	r	r
COCA	3	5	5	4	5	6	5	6	5	6	7	8	8	7	6	5	7	5	3	2	+	3	3	4	8	10	5	2	+	0
ACMI	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	2	2	3	3	0	2	3	2	2	3	+	3	+	0	+	+	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	2	+	0	0	0	0	2	0	0	0	0	0	0	0	+	2	0	r	0	0	r	+	r	r	r	0	r	r
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	r	+	+	0	+	r	r	+	0	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	2	r	0	2	3	r
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
GOOB	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	r	0	0	0	r	0	r	0	0	0	0	0	0	r	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	5	3	4	4	4	3	4	3	3	5	2	4	3	3	4	5	5	5	5	4	4	4	4	5	5	4	6	5	6
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	+
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	0	0	0	0	0	0	0	0	+	0
DIPO	r	0	0	r	0	r	0	+	0	0	0	0	0	0	r	2	0	0	r	+	r	0	0	+	4	0	0	r	r	0
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	39	72	60	72	58	49	65	55	37	68	61	64	63	58	50	73	63	84	68	39	78	81	72	39	22	35	36	28	23	25
PLSC	24	5	8	8	15	10	3	11	15	4	13	5	8	13	13	2	4	3	15	17	3	3	5	4	21	31	24	22	18	27
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	0	0	0	r	r	0	0	0	0	0	0	0	0	0	r	+	0	0	+	3	r	r	0	r	r	+	r	0	+	+
CLADONIA	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	r	0	0	r	0	r
PELT.	3	2	3	r	3	4	2	3	2	3	3	2	8	4	4	2	2	2	7	3	3	4	3	4	6	3	5	6	7	12
STEREO.	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table B-6. Continued (Whirlpool understorey 1989).

Species	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
SHCA	12	16	16	17	4	5	5	2	+	4	4	13	3	4	6	4	+	+	0	+	0	0	r	4	6	4	3	6	5	4
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
JUCO	2	8	+	3	r	r	r	r	0	0	2	8	2	2	+	0	0	0	0	+	3	0	0	0	0	r	+	r	6	7
ROAC	+	0	r	0	0	r	r	0	+	+	+	2	+	2	2	r	+	r	r	r	2	0	r	0	r	+	2	+	+	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
ARUV	3	2	4	3	3	0	0	r	0	0	2	2	r	0	r	0	0	0	0	0	0	0	0	0	2	r	0	r	3	3
LIBO	9	+	2	+	+	3	2	+	5	3	2	2	6	3	+	r	+	+	9	4	4	3	r	r	3	+	4	4	+	3
VACA	10	15	11	7	4	7	7	4	2	0	0	0	0	0	0	r	r	3	0	0	0	0	4	3	0	+	+	0	0	0
VASC	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	r	2	0	0	+	0	0	r	0	0	0	0	0	+	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0
CHUM	0	0	r	r	r	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	2	+	r	+	r	r	0	0	r	+	r	r	+	r	0	0	0	0	0	0	r	+	r	r	0	0	0	r	+	r
PYCH	0	r	r	r	r	0	0	r	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
COCA	0	3	5	5	7	5	3	2	0	r	2	3	5	4	6	8	6	7	18	20	6	7	7	4	4	4	4	4	0	0
ACMI	0	0	r	r	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	+	0	0	+	+	0	+	2	+	+	r	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	r	0	0	0	r	+	r	0	r	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	r	0	r	+	0	0	0	+	0	0	0	0	0	0	r	0	0	0	0	0	0	+	r	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	r	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
GOOB	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	4	5	5	4	4	4	4	4	4	5	5	4	3	4	4	3	4	5	4	7	7	4	4	4	4	4	5	5	5
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	r	r	0	0	0	0	0	0	0	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	+	r	+	0	2	0	0	0	4	+	+	r	0	0	0	0	0	0	0	0	0	0	4	3	0	r	5	+
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
HYSP	49	50	48	44	54	54	31	55	72	74	18	43	53	66	67	54	56	62	52	39	33	32	59	70	38	15	25	29	27	24
PLSC	4	6	3	15	2	3	6	16	r	2	19	16	15	2	8	7	5	+	2	0	r	5	r	0	10	43	32	15	24	23
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	0	+	2	0	0	0	0	0	0	0
CLADINA	r	r	r	r	r	+	2	r	0	r	+	+	0	r	+	r	0	0	r	0	0	0	0	0	+	r	0	0	r	r
CLADONIA	r	r	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r
PELT.	3	2	2	3	6	6	5	3	+	2	5	3	4	3	5	2	3	2	3	2	3	2	5	12	13	3	2	3	2	2
STEREO.	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SHCA	+	4	3	5	3	8	12	7	3	7	15	3	6	6	11	6	6	4	3	4	4	7	2	5	2	+	r	2	0	0
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	r	0	r	r	r	0	0	r	0	0
JUCO	0	0	0	0	4	4	+	+	0	r	r	0	r	0	r	+	3	0	3	6	5	3	0	r	0	3	0	0	0	0
ROAC	2	r	r	r	0	r	0	0	0	0	0	0	0	0	r	r	+	0	0	r	r	r	+	r	+	0	r	r	r	0
SALIX	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	2	3	5	5	4	0	r	8	6	4	6	4	3	4	0	0	0	+	0	0	r	r	0	0	0	0	0
LIBO	3	3	2	+	6	2	4	3	2	2	2	2	2	2	4	3	3	4	4	4	2	4	+	2	2	2	+	2	4	4
VACA	r	r	+	+	6	3	5	7	5	+	2	+	3	4	0	3	3	r	0	0	0	0	0	0	+	2	2	+	0	0
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
ORSE	0	r	r	r	r	0	r	0	r	+	+	r	0	0	+	r	r	0	r	r	r	r	0	r	0	0	r	r	0	r
PYCH	0	0	0	0	r	0	0	0	r	0	r	r	r	0	r	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0
COCA	0	3	3	3	4	7	6	6	3	+	4	4	3	2	2	2	3	3	2	0	2	r	5	5	4	3	4	4	13	13
ACMI	0	0	0	0	0	r	r	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	2	3	0	0	+	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	r	0	0	r	r	0	r	r	r	r	r	0	0	0	r	r	r	0	0	0	0	0	0	0	r	0	0	0	0
SOSP.	0	0	0	0	0	+	+	r	0	0	0	0	r	+	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	0	r
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	r	0	0	r	0	r	0	0	r	0	0	0	r	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	4	3	4	4	3	5	5	5	5	5	5	5	4	5	4	6	3	4	5	5	5	4	4	3	3	3	4	8	8
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	+	5	3	3	2	+	+	5	5	2	3	+	2	+	r	r	r	2	0	0	r	r	0	0	0	0	0
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	45	45	47	33	17	18	13	4	9	10	7	14	14	18	20	23	31	52	57	52	73	36	68	48	54	65	58	44	53	62
PLSC	3	5	4	15	15	13	14	10	17	18	21	8	15	21	20	24	25	13	6	12	15	28	4	9	5	0	2	+	2	0
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	r	r	r	r	r	0	0	r	+	+	r	2	+	r	r	+	r	r	r	r	r	0	0	r	r	0	0	0	0	0
CLADONIA	r	0	0	0	0	0	0	0	r	r	r	0	r	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0
PELT.	+	r	3	3	5	2	2	2	2	3	4	5	4	2	3	3	3	2	+	4	r	r	+	3	3	4	3	3	5	4
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0

Table B-6. Continued (Whirlpool understorey 1989).

Species	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
SHCA	+	+	0	0	+	2	3	2	4	4	10	4	+	2	6	5	4	5	6	6	6	5	2	2	6	4	4	2	4	6
LEGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	22	4	0	+	6	2	+	r	+	2	6	0	r	0	r	r	0	+	20	3	r	2	7	+	28	4
ROAC	r	0	r	r	+	r	+	+	r	+	r	r	0	r	r	r	r	+	r	r	r	r	r	r	+	r	+	r	r	+
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	r	0	0	0	0	0	0	r	2	+	6	3	0	r	3	5	3	4	11	8	4	6	5	3	4	+	r	0	3	r
LIBO	+	+	+	2	r	+	2	3	4	4	7	5	+	3	4	5	+	2	4	4	+	3	r	5	5	2	2	4	4	3
VACA	0	0	r	r	4	3	3	+	2	r	3	3	2	2	7	3	3	+	3	2	r	3	r	6	7	8	3	+	3	6
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0
ORSE	0	0	r	+	0	0	r	+	r	+	r	+	r	+	+	r	0	0	r	r	0	r	r	0	r	r	+	+	2	+
PYCH	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	r	0
COCA	5	4	5	5	8	4	3	4	+	3	r	0	0	r	+	3	5	4	5	5	3	4	+	4	5	3	+	2	3	3
ACMI	0	r	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	r	0	0	0	2	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	r	0	0	r	r	0	0	0	0	0	0	r	r	r	0	0	+	r	+	r	0	r	0	r	0	0	0	0	0
SOSP.	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	+	r
GELI	0	r	r	r	+	+	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	+	+	+	0	r
VIAD	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0
GOOB	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	r	0	0	r	r	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	4	5	3	2	5	5	4	3	4	5	4	3	4	3	4	4	5	5	5	5	4	3	3	4	5	3	3	3	5
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	+	+	r	+	2	6	+	r	r	+	+	+	5	4	5	3	+	0	0	0	r	2	r	r
DIUN	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	62	59	62	65	69	63	67	15	52	28	14	0	45	49	35	20	29	21	16	7	9	+	25	38	21	20	23	33	4	11
PLSC	+	r	2	0	0	5	6	26	4	39	33	52	15	20	25	32	0	23	25	30	25	30	18	25	18	16	25	16	24	21
POJU	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
PTCR	+	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	0	0	0	0	0	0	0	0	r	+	+	2	r	r	r	+	r	+	r	r	r	2	r	+	r	r	r	r	r	r
CLADONIA	0	0	0	0	0	0	0	r	0	r	+	0	r	r	r	r	0	r	r	0	r	r	r	0	0	r	r	r	0	0
PELT.	3	5	3	3	3	2	4	2	5	2	5	4	+	2	4	7	5	6	5	3	4	3	r	+	2	3	2	3	4	3
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
SHCA	3	8	7	3	4	+	r	r	r	0	0	0	0	0	0	3	4	3	2	6	8	5	4	3	7	6	5	7	4	4
LEGR	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	0	0	0	r	r
JUCO	2	3	+	r	0	+	0	0	r	0	r	0	0	0	4	3	0	4	35	3	r	0	r	3	r	0	4	4	+	5
ROAC	r	0	r	r	+	+	0	0	0	0	+	r	r	0	0	r	+	+	+	r	2	r	+	+	r	+	+	r	r	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	r	r	0	0	0	0	0	0	0	0	0	+	r	2	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	4	3	2	0	0	0	0	0	r	0	0	0	0	0	0	0	r	4	3	2	3	9	8	0	3	3	4	5	r	2
LIBO	5	5	4	4	5	5	3	2	2	4	4	4	5	3	3	4	4	3	2	2	3	4	5	3	3	5	4	4	2	+
VACA	2	4	+	3	2	4	0	r	r	+	2	4	2	r	2	2	+	2	4	8	0	0	6	0	3	3	4	2	3	2
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	+	+	r	+	+	+	0	0	0	0	0	0	r	0	r	r	r	2	+	r	2	r	r	r	r	r	r	r	r
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	r	0	0	0	0	0	0	0	r
COCA	4	5	3	5	5	12	4	4	5	3	7	9	8	4	10	5	5	4	3	5	4	r	0	2	2	3	3	+	3	4
ACMI	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	+	0	+	r	+	0	0	0	0	0	0	0	0	+	3	2	0	+	0	2	0	+	0	0	0	0	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	+	+	r	0	0	0	0	0	r	0	0	0	0	r	r	0	+	r	0	0	r	0	0	0	0	r	r	0	r
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	2	0	0	0	r	2	+	r	+	+	+	+	0	r	+	r	0	0	+	2	+	r	+	+	0	0	0	r	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
EPAN	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	r	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	r	0	0	r	0	0	0	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	4	4	4	4	4	4	2	5	5	5	5	4	3	3	3	3	3	2	3	5	7	5	4	4	5	4	3	4	5
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	3	2	2	4	+	0	0	0	0	0	0	0	0	0	0	0	r	r	r	2	0	+	2	0	0	r	0	+	3	2
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
HYSP	18	27	17	31	59	76	48	70	62	72	64	60	65	69	59	49	72	32	22	31	22	2	0	13	3	3	3	+	+	2
PLSC	36	26	25	3	3	0	0	0	0	0	3	2	0	0	0	20	3	20	28	23	7	2	27	28	35	36	32	23	21	29
POJU	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
PTCR	0	0	0	0	0	0	0	3	0	3	3	9	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	r	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	r	r	0	r	+	r
CLADONIA	0	r	0	r	r	0	r	0	0	0	0	0	0	r	r	0	0	r	0	0	0	0	0	0	0	0	0	r	r	r
PELT.	3	r	4	3	2	4	5	3	4	2	3	4	r	5	4	4	5	4	0	2	+	r	r	2	+	2	2	2	2	2
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table B-6. Continued (Whirlpool understorey 1989).

Species	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
SHCA	5	9	6	15	8	4	5	17	8	6	7	4	6	2	+	0	0	0	0	0	0	0	0	0	0	3	5	5	8	7
LBGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	+	0	r	+	2	2	0	0	0	0	0	3
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	r	r	0	0	0	r	r	0	r	0	0	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
JUCO	3	6	35	22	+	4	2	5	0	+	0	4	r	0	0	2	0	0	0	+	0	1	+	0	0	+	0	4	+	+
ROAC	r	r	r	+	+	r	+	0	+	2	+	+	r	0	+	0	0	0	r	r	+	r	0	0	+	r	r	+	+	+
SALIX	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	+	0	0	+	+	0	r	0	0	0	0	0	0	0	0	0	+	+	0
ARUV	2	6	7	8	6	7	3	5	4	5	4	2	2	r	0	0	0	0	0	0	0	0	0	0	0	0	+	3	3	3
LIBO	3	+	2	4	4	2	3	3	4	5	6	3	2	2	r	3	2	7	4	2	5	3	+	0	3	2	2	0	2	3
VACA	2	2	3	4	5	3	r	3	3	4	7	4	2	0	2	r	0	3	2	0	r	r	0	0	0	0	r	r	0	2
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+
CHUM	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	+	0	0	0	r	r	+	r	r	0	0	0	+	0	+	0	+	+	0	+	0	0	0	r	r	r	r	0	r
PTCH	0	0	0	0	r	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
COCA	4	3	3	3	3	4	5	3	5	5	9	5	4	4	7	7	4	6	5	5	5	5	5	4	5	6	4	2	3	4
ACMI	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	0	0	0	0	0	0	0	0	0	0	0	0	2	r	+	+	0	0	0	0	0	0	0	0	0	+	2	0	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	r	r	r	r	r	0	0	0	0	0	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	r	r	+	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
GOOB	0	0	r	r	0	0	r	0	r	r	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	2	+	3	5	4	5	3	7	5	4	4	5	3	3	3	3	5	4	6	5	5	3	3	4	4	4	4	4	4
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	2	0	r	+	0	+	+	4	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	r	2	+	2
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
HYSP	37	33	32	16	7	14	8	19	15	4	5	39	25	45	71	69	78	55	47	47	47	52	59	63	72	48	33	26	13	15
PLSC	6	+	2	15	17	17	16	9	10	21	29	25	38	10	0	0	3	0	2	3	3	2	2	4	+	10	18	5	20	17
POJU	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	5	15	19	6	4	17	4	0	+	+	0	0	0	0
CLADINA	r	r	r	r	r	+	r	0	r	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
CLADONIA	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0
PELT.	+	+	6	2	3	2	+	r	2	2	r	2	3	+	+	3	2	2	+	7	5	2	3	3	3	2	2	3	+	+
STEREO.	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
SHCA	4	18	3	2	3	8	8	7	4	5	6	5	5	8	7	3	+	3	4	10	6	3	6	15	6	+	0	0	+	2
LBGR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	0	0	3	0	+	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	r	r	r	r	0	0	0	r	0	+	+	r	+	0	+	r	+	r	r	r	0	0	0	0	0	0	0	0	0	0
JUCO	0	r	7	4	9	3	+	3	r	0	0	0	4	3	+	5	2	+	r	3	+	+	2	2	3	r	0	0	0	0
ROAC	+	+	+	+	r	+	r	0	r	r	r	+	0	+	0	+	+	+	+	r	r	+	+	r	r	0	0	0	0	+
SALIX	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	+	3	8	4	2	7	6	4	3	2	0	4	3	3	5	7	5	4	0	3	2	2	+	+	0	0	0	0	0	r
LIBO	3	3	4	+	3	4	4	3	2	3	3	+	+	+	2	r	2	3	2	4	3	+	3	+	+	0	0	+	+	2
VACA	3	2	2	r	3	3	3	2	2	+	4	2	2	+	+	2	3	4	3	2	2	2	4	3	0	+	0	r	r	+
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRVI	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	r	0	0	0	0	0	0
CHUM	r	0	0	r	0	0	0	0	0	r	0	r	0	0	0	0	0	0	r	+	0	0	0	0	0	0	0	0	0	0
ORSE	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	r	+	+	r	0	0	0	0	0	0	r	0	0	0	r
PTCH	0	r	0	r	0	0	r	r	0	r	0	r	0	0	0	0	0.0	0	0	0	r	0	0	0	0	0	0	0	0	0
COCA	6	5	2	+	3	3	4	5	3	4	4	4	4	3	3	+	+	2	3	4	6	5	6	5	5	4	3	4	3	4
ACMI	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	+	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	+	0	0	+	+	r	0	0	0	0	+
ASCI	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
ASCO	0	r	r	r	0	0	r	r	+	r	r	r	0	r	r	r	r	0	r	0	0	0	0	r	0	0	0	0	0	0
SOSP.	0	0	0	0	0	r	0	r	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
GELI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	+	0	0	0	0	r
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0
LAOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0
GOOB	r	r	r	0	0	0	r	0	0	0	0	r	0	r	0	0	0	r	r	0	0	r	0	0	0	0	0	0	0	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	4	4	4	5	3	4	4	5	5	5	4	5	4	4	0	5	5	5	5	2	4	3	4	3	3	2	2	2	2	4
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	8	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	2	4	r	+	+	0	2	+	+	+	+	r	r	r	r	+	2	+	2	r	4	0	0	0	0	0	0	0
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	16	12	5	0	14	7	5	22	12	16	7	15	6	21	15	16	20	13	9	19	25	52	53	64	71	65	60	62	66	66
PLSC	17	29	8	15	14	22	33	28	26	21	20	22	32	15	17	6	3	7	7	17	17	14	3	2	2	2	3	3	2	+
POJU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	3	7	4
CLADINA	0	0	0	2	r	r	r	r	+	+	r	r	4	0	r	2	r	0	0	0	0	r	r	r	0	0	0	0	0	0
CLADONIA	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
PELT.	2	+	r	r	r	r	+	+	r	2	+	+	+	r	+	r	+	0	r	r	2	2	2	2	r	6	6	8	+	2
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0

Table B-6. Continued (Whirlpool understorey 1989).

Species	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
SHCA	r	0	2	r	+	3	+	8	+	3	6	6	+	3	3	4	12	4	8	7	6	5	4	4	7	4	2	5	10	4
LEGR	0	0	4	5	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	r	+	r	r	r	r	+	+	3	+	r	r	r	+	2	0	0	r	r	0	r
JUCO	0	0	0	0	0	+	0	r	0	r	12	+	0	2	13	4	2	+	0	0	0	+	2	+	7	7	+	4	0	2
ROAC	0	0	0	0	+	r	+	2	+	r	+	+	r	2	+	r	0	0	r	r	+	+	r	r	r	+	+	+	+	r
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARUV	0	0	0	0	0	0	+	3	+	r	2	7	5	+	3	4	5	5	3	5	5	4	6	10	3	5	6	4	4	5
LIBO	2	r	r	r	r	+	4	2	3	2	2	2	2	r	+	2	2	+	2	+	3	2	2	2	2	2	2	+	3	3
VACA	r	r	0	+	2	r	2	+	2	r	0	0	+	2	3	3	2	5	2	3	3	0	+	3	3	3	r	4	3	r
VASC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	r	0	0	0	0	0	+	0	r	0	0	0	0	0	0	0	0	0	0	r	3	2	r	r
CHUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	r	0
ORSE	r	0	0	0	0	+	r	0	0	r	r	r	+	0	0	0	0	0	0	r	r	0	0	0	r	0	0	0	0	0
PYCH	0	0	0	0	r	r	r	0	0	0	0	0	r	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0
COCA	4	4	3	5	6	4	6	5	4	3	3	3	r	0	r	r	4	4	4	5	4	3	3	r	r	2	3	3	5	3
ACMI	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
ARCO	+	0	0	0	0	0	+	+	r	0	0	0	0	0	r	+	0	0	0	0	r	0	0	0	0	0	0	0	+	r
ASCI	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	r	0	0	0	r	0	0	r	r	0	r	+	r	r	0	r	+	0	r	r	0	0	r	0	0	r	0
SOSP.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARO	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
EPAN	0	r	r	r	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
LAOC	0	+	+	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
TRRE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	r	0	r	0	r	0	r	0	r	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0
HAOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	5	2	2	2	5	4	3	5	3	4	2	5	6	5	4	5	5	5	5	5	5	5	5	5	5	4	5	4	4	5
TRSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	4	21	4	0	0	0	0	0	0	0	0	0	0	+	3	0	0	0
DIPO	0	0	0	0	r	0	0	4	2	+	+	+	0	r	2	2	0	0	+	0	+	+	+	r	+	+	r	r	r	r
DIUN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	35	55	54	55	40	68	58	28	29	19	22	7	13	9	5	3	13	16	27	22	15	21	12	13	12	23	12	19	16	5
PLSC	24	10	4	3	2	5	2	21	21	19	25	33	14	11	12	7	20	24	25	18	17	18	9	14	17	23	15	16	22	8
POJU	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	+	4	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADINA	0	0	0	0	0	0	r	r	r	r	r	0	0	0	+	0	0	r	0	r	0	r	0	r	r	r	r	0	0	0
CLADONIA	0	0	0	0	0	0	0	r	r	r	0	r	r	0	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r
PELT.	5	4	2	2	8	4	3	5	3	4	2	r	r	+	2	r	2	r	2	2	+	+	r	+	+	+	+	r	r	+
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	391	392	393	394	395	396	397	398	399	400
SHCA	4	4	4	+	+	3	+	0	5	0
LEGR	0	0	0	0	0	0	3	3	0	0
LOIN	0	0	0	0	0	0	0	0	0	0
SOSC	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	r	0	0	0	0	0	0	0
JUCO	15	3	0	0	0	0	0	0	+	0
ROAC	+	+	+	r	+	r	+	+	r	r
SALIX	0	0	0	0	0	0	0	0	0	0
ALCR	0	0	0	0	0	0	0	0	0	0
VIED	0	0	0	0	0	0	0	0	0	0
ARUV	3	4	2	0	0	r	r	0	0	0
LIBO	0	3	+	+	2	3	2	r	+	2
VACA	+	2	2	0	0	+	r	r	0	r
VASC	r	0	0	0	0	0	0	0	0	0
FRVI	0	0	0	0	0	0	0	0	0	0
CHUM	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	r	0	+	+	0	0	0	0
PYCH	0	0	r	r	0	0	0	0	0	0
COCA	4	5	5	6	6	5	6	5	0	4
ACMI	0	0	0	0	0	0	0	0	0	0
AGOS.	0	0	0	0	0	0	0	0	0	0
ARCO	0	r	r	0	r	0	0	r	0	r
ASCI	0	0	0	0	0	0	0	0	0	0
ASCO	0	0	0	0	r	0	+	r	0	0
SOSP.	0	0	0	0	0	0	0	0	0	0
GELI	0	0	0	0	r	r	0	0	0	0
VIAD	0	0	0	0	0	0	0	0	0	0
CARO	0	0	r	r	0	0	0	0	0	0
EPAN	r	0	r	r	r	r	r	r	0	0
LAOC	0	0	0	0	0	0	r	0	0	0
TRRE	0	0	0	0	0	0	0	0	0	0
ZIEL	0	0	0	0	0	0	0	0	0	0
CABU	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0
HAOR	0	0	r	0	0	0	0	0	0	0
ELIN	3	3	2	2	3	4	3	2	5	4
TRSP	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0
DIPO	+	2	r	0	0	r	r	0	0	0
DIUN	0	0	0	0	0	0	0	0	0	0
HYSP	14	12	38	72	58	65	48	68	31	60
PLSC	17	17	12	0	0	8	3	0	25	3
POJU	0	0	0	0	0	0	0	0	0	0
PTCR	0	0	0	0	0	0	0	0	0	0
CLADINA	+	0	r	0	0	0	0	0	0	0
CLADONIA	0	0	r	0	0	0	0	0	0	0
PELT.	2	4	4	2	2	6	+	4	r	2
STEREO.	0	0	0	0	0	0	0	0	0	0

Table B-7. Understorey species cover estimates for Hector 1967.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SHCA	0	0	0	0	0	1	2	0	0	0	0	1	1	2	2	1	0	0	1	0	0	0	r	0	+	1	1	1	+	0
LEGR	r	1	+	+	+	+	+	r	r	+	+	r	0	0	+	+	+	1	+	r	+	+	r	r	0	r	0	r	0	+
MEFE	4	5	4	5	4	4	3	4	4	5	4	4	4	2	2	4	3	4	4	4	5	5	5	4	5	3	4	4	4	5
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
SALIX	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	0	r	r	r	0	0	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r
VAMY	0	r	0	0	0	0	2	+	r	0	0	0	r	0	0	0	r	+	+	r	+	+	r	r	0	0	0	0	r	+
VASC	+	r	+	+	+	1	+	+	+	1	+	+	1	+	1	+	+	+	+	1	+	+	1	r	+	1	1	+	+	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	r	+	r	r	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0	+	+	+	0	0	0
ARCO	0	0	+	+	0	r	r	+	r	+	r	r	+	+	+	r	0	r	r	r	r	r	r	r	+	r	r	+	+	+
EPAN	0	0	r	0	0	r	r	0	0	r	0	r	r	r	r	r	0	0	0	0	r	r	r	r	r	r	r	r	r	r
EMNI	0	0	0	0	0	0	0	r	r	0	r	+	0	0	0	0	0	0	0	0	0	0	+	r	0	0	0	r	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	r	r	0	0	0	0	0	r	r	0	r	0	0	0	0	0	0	r	r	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	1	r	+	+	0	0	0	r	r	+	+	r	+	0	r	r	r	+	r	0	r	0	+	0	+	+	0	r	r	0
HYSP	0	+	0	0	0	0	r	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	r	0	0	0	0	r	0
PLSC	5	5	2	1	+	1	+	+	2	3	1	2	1	1	2	+	3	4	2	1	2	2	2	3	2	2	2	1	1	2
POJU	0	r	0	0	r	0	r	0	0	0	r	r	r	0	0	0	r	r	r	r	r	r	0	0	0	+	0	0	0	0
PTCR	+	r	0	0	r	0	r	0	+	+	0	0	0	0	r	0	0	r	r	0	r	r	r	0	r	+	0	r	0	0
CLADONIA	+	+	+	r	+	+	+	+	+	r	+	+	+	1	+	+	r	+	r	+	+	r	+	r	+	1	r	+	+	r
PELT.	r	+	+	+	r	+	+	+	+	r	+	r	+	+	r	r	+	1	0	+	+	r	0	r	r	+	r	+	r	r
STEREO.	0	0	0	0	r	r	r	0	0	0	0	r	+	r	r	0	0	0	0	0	0	0	r	r	r	+	0	r	0	0

Species	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
SHCA	+	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	0	r	0	r	2	+	+	2	r	2	+	0	0	0
LEGR	r	0	r	+	+	r	+	r	0	0	0	r	0	+	+	+	0	0	r	r	+	0	0	0	0	r	0	r	+	1
MEFE	5	4	4	4	3	4	4	5	4	4	4	4	6	4	5	4	4	5	4	4	4	4	5	3	4	4	4	4	5	5
RHAL	1	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	+	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
SALIX	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	r	r	r	r	r	r	0	0	0	r	0	r	r	r	r	r	r	r	r	0	0	r	0	r	0	0	0	0
VAMY	r	r	0	+	r	0	+	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0	+	0	r	0	0	r	r
VASC	+	1	+	r	+	r	r	+	1	r	r	1	+	r	r	+	1	+	1	1	+	+	+	+	1	+	+	+	r	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	r	+	r	+	r	0	r	r	r	0	0	r	r	0	r	r	+	r	r	+	r	r	0	r	r	r	0	0	0	0
ARCO	+	+	0	0	+	0	+	r	r	0	r	+	r	+	r	+	+	r	+	+	+	+	+	+	+	+	r	r	0	0
EPAN	0	r	r	r	r	0	0	0	r	0	0	r	0	0	r	r	r	r	r	r	r	r	0	r	r	0	0	0	0	0
EMNI	0	0	0	r	0	0	r	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	r	0	r	0	0	0	0	0	0	r	0	0	0	r	r	r	r	r	r	0	0	0	r	0	r	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
DIPO	r	r	r	r	r	+	r	+	1	+	r	1	+	+	+	+	+	+	+	+	+	+	r	r	+	+	r	+	r	r
HYSP	0	0	r	0	0	0	0	0	+	+	0	0	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	1	1	1	1	+	1	1	2	3	2	3	2	1	1	3	2	2	1	1	2	1	1	1	1	3	5	3	4	1	3
POJU	0	0	0	0	0	0	0	r	1	r	0	r	0	0	0	+	+	r	+	+	r	r	r	r	r	0	r	+	0	0
PTCR	r	r	+	0	0	0	0	0	0	r	0	r	0	r	r	r	0	0	r	r	0	r	r	r	+	0	r	0	r	+
CLADONIA	r	1	r	r	+	2	r	+	1	r	+	+	+	+	+	1	1	+	+	+	+	r	+	+	+	r	r	+	1	r
PELT.	r	+	+	1	1	0	+	+	+	1	0	r	0	r	r	r	0	0	r	r	0	r	r	r	+	0	r	0	r	+
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	+	r	0	r	+	+	0	0	r	0	r

Species	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
SHCA	r	+	1	1	r	1	2	0	0	r	2	+	1	0	0	r	r	0	1	+	0	0	1	1	1	2	+	r	0	0
LEGR	+	+	r	0	0	0	0	r	0	0	0	0	r	r	+	+	0	r	r	0	r	0	0	0	0	0	0	0	0	0
MEFE	5	5	4	3	4	3	3	4	5	5	2	4	4	4	4	3	2	5	4	5	5	5	3	3	2	1	1	4	5	5
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	r	r	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	0	0	0	0	0	r	r	+	r	r	0	0	0	0	0	r	0	0	r	r	+	r	+	+	r	r	r
VAMY	0	+	r	0	0	r	+	0	0	0	0	0	0	r	+	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0
VASC	+	1	+	1	1	1	+	1	1	r	+	+	r	+	1	r	r	+	+	+	1	r	+	+	1	1	1	1	+	r
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	+	0	0	r	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	r	0	0	0	0	0	r	0	r	r	r	r	0	0	0	r	0	0	0	r	r	r	r	0	0	r	r	r
ARCO	r	r	r	+	r	r	+	+	+	1	+	r	+	+	r	r	r	+	1	r	0	+	+	r	+	r	r	r	+	+
EPAN	0	0	0	0	0	0	r	0	r	0	r	0	r	0	0	0	0	r	r	0	r	0	0	0	r	0	r	0	r	0
EMNI	0	0	0	0	0	0	0	0	0	0	0	+	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	0	0	r	0	0	0	r	0	r	r	r	r	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	+	0	+	+	r	+	0	+	0	r	0	+	r	+	r	r	+	0	r	0	+	+	r	r	r	r	r	0	0
HYSP	0	0	0	0	r	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	2	2	1	2	2	2	2	2	3	1	1	2	2	1	1	1	+	1	3	5	1	r	r	1	+	r	+	+	2	2
POJU	0	0	r	r	0	r	0	0	0	r	r	0	0	r	0	0	0	0	0	0	0	r	r	0	+	r	+	r	r	0
PTCR	+	0	r	r	r	r	0	r	0	0	+	+	0	r	r	r	r	0	r	r	0	0	0	r	0	0	0	0	0	r
CLADONIA	r	r	r	1	1	1	1	+	+	+	1	r	+	r	2	1	+	r	+	r	r	r	+	r	+	1	1	1	r	r
PELT.	r	0	r	+	r	0	0	r	+	+	1	+	+	1	+	+	1	2	+	0	0	1	1	+	+	1	1	r	r	+
STEREO.	0	0	r	r	r	0	r	0	0	0	+	0	r	0	0	0	0	r	r	0	0	0	0	0	r	+	+	r	0	r

Table B-7. Continued (Hector understorey 1967).

Species	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SHCA	+	+	0	0	r	+	1	1	0	+	2	+	+	1	1	+	+	0	+	0	0	+	1	2	3	1	2	0	+	0
LEGR	0	0	0	r	r	+	+	r	+	+	0	r	0	0	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	4	5	5	4	5	5	4	3	4	5	3	4	4	2	4	5	5	5	4	4	4	3	4	2	+	3	2	1	4	5
RHAL	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	r	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	+	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	1	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	r	r	r	0	r	r	0	r	0	0	r	r	r	r	0	r	r	r	0	0	r	r	r	r	+	r	+	r	r	0
VAMY	r	0	0	r	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	r	0	0	r	0	0	r	0	0	0	0
VASC	+	+	+	+	r	+	r	1	+	+	+	r	+	1	1	+	+	+	+	+	1	1	1	+	1	+	+	+	1	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	r	0	0	0	0	r	r	r	r	r	+	r	r	+	r	0	0	0	0	0	0	0	0	r	r	r	+	r	0	0
ARCO	+	+	+	+	1	+	1	1	+	+	r	1	1	+	+	1	+	+	+	0	0	+	r	r	r	0	r	+	+	0
EPAN	r	0	0	0	0	0	0	r	r	0	0	r	r	0	r	0	0	r	0	0	0	0	r	r	r	r	0	0	0	0
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	+	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	r	r	r	0	r	r	r	r	0	0	1	r	r	r	r	r	0	0	r	r	r	r	r	r	0	r	0	r	r	r
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	+	0	r	0	0	r	r	+	0	0	+	+	r	r	r	0	0	+	+	+	r	0	0	r	0	0	0	0	+
HYSP	0	0	0	0	0	r	r	0	0	0	0	r	0	0	0	0	r	r	0	0	r	0	0	0	0	0	0	0	0	0
PLSC	3	2	1	2	3	2	1	2	1	2	+	1	2	r	1	+	3	3	2	3	1	1	2	r	+	1	+	r	2	4
POJU	r	r	0	0	0	0	0	0	0	0	r	0	0	r	r	0	r	0	r	0	r	r	0	r	+	r	0	r	0	0
PTCR	r	0	0	0	r	0	r	0	0	r	r	r	r	0	0	0	+	r	r	r	r	0	0	0	0	+	0	0	0	0
CLADONIA	+	+	r	r	r	r	r	r	r	r	r	r	+	1	1	r	+	r	r	2	1	1	1	+	2	1	r	+	+	r
PELT.	r	r	+	+	r	+	0	r	0	+	r	r	r	0	0	0	+	r	r	r	r	0	0	0	0	+	0	0	0	0
STEREO.	r	0	0	0	0	r	0	r	0	0	r	0	0	r	r	0	0	0	0	0	+	0	0	r	r	r	+	r	0	0

Species	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
SHCA	0	1	0	2	2	1	1	+	+	0	0	+	r	r	+	1	2	0	1	0	1	1	1	+	0	+	0	+	0	1
LEGR	0	0	0	0	0	0	r	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	r	+	+	r	0	0	r
MEFE	5	4	3	3	4	4	4	4	3	1	2	3	4	3	4	3	3	4	2	3	2	2	1	4	5	4	4	4	3	3
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	r	r	0	0	0	0	0	0	0	0
JUCO	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0
SALIX	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	r	+	+	r	0	0	r	r	r	r	r	r	r	r	r	r	+	r	+	+	r	0	0	r	r	r	+	+
VAMY	+	r	r	0	0	0	0	0	r	r	0	0	0	0	0	r	+	r	r	0	0	0	+	r	+	r	0	r	0	0
VASC	1	+	+	1	+	+	+	r	1	1	+	r	r	+	r	+	1	+	+	+	1	1	+	+	+	+	1	+	+	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	r	r	0	r	0	0	0	0	0	0	0	r	r	r	+	+	r	r	r	r	0	0	0	0	0	0	0
ARCO	r	r	r	0	r	+	r	0	+	r	r	+	+	1	1	1	r	+	1	+	+	+	r	+	r	r	+	+	+	+
EPAN	0	r	0	r	0	r	r	0	0	0	0	r	0	0	0	r	0	0	r	0	0	0	r	0	0	r	r	r	0	r
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	r	r	r	r	r	r	0	0	r	r	r	r	0	r	r	r	r	r	r	r	0	r	r	0	r	r	r	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	+	+	r	+	r	r	r	+	+	+	r	r	+	r	r	0	0	r	r	r	r	r	r	r	r	r	0	r	+	r
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
PLSC	1	r	+	r	r	1	1	1	3	r	+	3	2	2	1	1	1	1	+	0	r	+	1	+	1	+	+	2	1	1
POJU	r	r	0	r	0	0	r	r	r	+	r	0	r	0	r	r	r	0	0	0	r	0	0	r	0	0	0	r	0	0
PTCR	r	0	0	0	r	r	r	r	0	r	0	r	0	r	r	r	r	r	+	0	0	r	0	0	0	r	0	0	0	r
CLADONIA	1	+	+	1	+	r	1	r	r	+	+	1	r	+	r	1	r	+	+	+	1	+	1	+	r	+	1	+	+	+
PELT.	r	r	+	+	0	r	1	r	+	+	r	1	+	0	+	+	1	2	1	0	+	+	1	1	+	+	r	+	1	r
STEREO.	0	0	r	r	0	r	r	r	r	+	r	+	0	0	r	+	0	0	r	r	0	r	r	0	0	0	r	r	0	r

Species	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
SHCA	1	0	0	r	0	2	2	+	+	0	1	+	+	2	3	2	1	0	3	2	r	2	2	1	0	0	0	+	0	0
LEGR	+	r	+	+	0	0	+	r	r	r	+	r	r	0	0	0	0	+	0	0	0	0	0	+	+	+	+	r	0	0
MEFE	2	4	4	3	3	2	2	5	5	5	4	4	4	3	1	3	4	3	2	3	3	3	2	5	4	5	5	2	3	4
RHAL	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
JUCO	r	0	0	0	0	0	r	0	0	0	0	+	r	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0
SALIX	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	r	r	0	r	r	r	r	r	0	0	0	0	0	r	+	r	r	0	r	+	r	+	r	r	r	0	0	+	+	0
VAMY	0	0	0	0	0	0	0	0	0	r	0	0	0	+	+	+	+	+	r	0	0	0	0	0	0	0	0	+	0	0
VASC	+	+	+	+	+	+	+	+	+	1	+	+	1	2	1	+	+	1	+	r	r	1	+	r	+	+	+	r	1	1
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r
ARCO	+	+	r	r	r	0	0	r	0	+	+	+	r	r	0	r	r	r	+	r	r	+	r	r	+	r	r	r	+	+
EPAN	0	r	r	r	r	0	r	r	r	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	r	0	r	r	0	0
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	r	0	r	r	r	0	r	0	0	r	r	0	0	r	r	r	0	r	0	r	0	r	r	0	r
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	r	+	+	r	r	0	r	r	+	r	r	r	0	r	r	r	r	r	r	r	0	r	r	r	+	r	r	r	r
HYSP	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
PLSC	1	1	1	2	1	r	r	+	2	1	+	+	r	+	+	1	1	1	1	+	r	1	+	2	1	+	1	+	1	1
POJU	0	0	0	r	0	r	0	0	0	0	r	0	0	0	0	0	0	r	r	r	0	0	0	+	0	r	0	0	r	0
PTCR	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	r	0	0	r	0
CLADONIA	+	1	1	+	1	+	1	+	1	+	+	1	1	+	1	+	1	+	+	r	1	+	1	+	+	+	r	2	+	+
PELT.	+	r	r	r	r	r	r	+	r	+	r	+	0	1	+	+	r	+	r	1	1	r	+	+	+	r	+	1	1	r
STEREO.	r	r	0	0	r	r	+	0	0	r	r	r	r	r	r	+	r	r	r	0	+	r	+	0	r	0	r	0	0	0

Table B-7. Continued (Hector understorey 1967).

Species	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
SMCA	0	0	+	0	0	1	2	+	1	2	3	r	0	1	1	+	1	1	+	0	0	+	+	1	+	+	0	1	0	0
LEGR	0	0	r	0	0	r	0	+	+	0	0	0	0	+	+	0	+	+	+	+	+	+	0	0	0	0	0	r	0	r
MEFE	4	4	3	4	4	4	2	3	4	4	1	4	5	4	3	4	1	4	5	4	5	4	4	5	4	4	5	4	2	4
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	r	r	0	r	0	r	0	0	r	r	r	0	0	r	r	+	r	0	0	0	0	0	0	r	0	0	0	r	0
VAMY	0	0	r	+	1	r	r	0	r	r	+	+	0	0	r	+	+	0	0	r	r	r	+	+	r	r	r	0	r	r
VASC	1	+	+	+	+	+	+	2	2	+	1	1	+	+	1	r	1	+	+	+	1	+	r	+	+	r	r	+	1	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	r
PYCH	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	+	+	+	+	r	r	r	1	+	r	r	r	r	r	r	r	r	0	0	0	0	r	0	r	+	r	r	+	1	r
EPAN	0	0	0	r	r	r	0	r	r	0	0	0	r	0	0	r	0	r	0	0	r	r	0	0	0	0	0	r	0	r
EMNI	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	r	r	r	r	r	0	r	0	r	r	r	r	0	r	0	0	r	r	r	0	0	0	0	r	r	0	0	r	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	+	0	0	0	0	r	r	r	r	r	r	r	r	r	r	0	+	r	r	+	r	r	+	r	0	r	0	r
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	r	+	0	+	1	+	1	0	r	1	+	+	1	+	r	1	r	r	+	r	3	3	2	+	1	1	2	2	3	2
POJU	0	0	r	0	0	0	r	0	r	r	r	0	0	r	r	r	r	0	0	0	0	0	0	0	r	0	r	0	r	0
PTCR	r	0	r	r	0	0	0	0	r	0	0	0	0	r	r	0	+	0	0	0	0	r	0	0	r	0	r	0	r	r
CLADONIA	r	+	1	1	+	+	+	1	+	+	1	r	+	+	+	+	1	+	1	1	+	+	1	+	1	+	r	r	r	r
PELT.	r	+	0	+	1	+	1	0	r	1	+	+	1	+	r	1	r	r	+	r	r	r	r	r	+	+	+	r	1	r
STEREO.	0	r	0	r	r	0	r	r	0	r	r	0	0	r	r	0	0	r	r	+	0	r	r	0	r	0	0	0	r	0

Species	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SMCA	0	0	+	2	1	1	+	0	1	r	+	1	2	2	1	1	1	1	0	+	0	+	0	0	+	+	+	+	0	2
LEGR	+	0	0	0	0	0	0	0	0	0	0	+	0	0	0	+	0	0	0	+	+	0	0	r	0	0	+	+	+	r
MEFE	4	4	4	3	4	3	3	1	2	4	4	3	1	2	3	3	5	4	4	3	4	1	2	4	3	5	5	4	5	4
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	+	+	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	r	0	0	r	0	r	r	0	r	+	r	+	r	r	r	0	0	0	0	r	0	0	0	0	0	r	r	0	0
VAMY	r	1	1	r	r	1	+	0	0	0	0	0	0	r	r	0	0	r	0	0	r	0	+	0	0	0	0	0	r	r
VASC	+	+	+	+	1	1	+	+	+	+	1	1	+	+	+	1	+	+	+	+	+	1	1	+	1	+	+	1	+	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	r	0	r	r	0	0	0	r	r	r	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	1	+	r	r	r	+	+	r	+	+	+	r	r	r	+	r	+	+	+	+	r	+	+	+	1	1	+	+	+	+
EPAN	0	r	r	0	0	0	+	0	0	r	r	0	0	0	r	0	r	0	0	r	0	r	r	r	r	r	0	r	r	r
EMNI	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	r	0	r	0	0	r	r	r	r	r	r	r	r	r	r	r	0	0	0	r	r	0	0	0	r	0	0	r	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	r	0	0	r	r	0	0	r	r	0	r	r	+	+	r	r	+	r	r	r	r	+	r	0	0	+	+	r	r	+
HYSP	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
PLSC	1	2	1	1	r	+	2	1	1	1	+	1	+	1	1	2	2	2	1	1	2	+	1	1	1	2	2	2	2	2
POJU	r	0	r	r	0	0	r	r	r	r	r	r	+	r	0	0	r	r	0	r	r	r	r	r	r	0	0	0	0	0
PTCR	0	r	0	+	r	0	+	r	r	r	r	0	0	0	r	0	0	r	0	0	+	0	r	r	r	+	r	r	r	r
CLADONIA	r	+	+	1	1	+	+	1	+	r	+	+	+	r	+	1	+	r	+	+	+	+	r	r	+	+	0	r	0	r
PELT.	+	0	r	r	+	1	+	+	r	0	+	+	+	r	+	1	+	r	+	+	+	+	r	r	+	+	0	r	0	r
STEREO.	0	0	0	0	0	r	0	0	r	0	r	r	0	r	+	r	0	r	0	0	r	r	r	0	0	0	0	r	0	0

Species	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
SMCA	0	1	1	1	1	+	+	0	1	1	0	+	1	1	1	+	2	2	0	0	0	0	r	0	r	1	3	1	2	1
LEGR	r	+	r	0	0	0	0	+	0	+	r	0	0	0	0	0	r	0	+	+	+	+	r	r	r	+	0	0	0	0
MEFE	4	2	2	2	3	2	3	4	2	4	4	4	3	3	1	1	1	2	4	5	4	5	4	4	4	1	+	2	3	4
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	r	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	+	0	r	0	0	0
SALIX	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	0	0	0	0	0	+	r	r	r	r	+	+	r	r	r	r	r	0	r	0	r	r	0	+	r	r	r
VAMY	+	+	+	+	1	r	+	0	r	+	r	r	r	r	r	0	r	0	0	0	r	0	r	+	r	0	+	r	r	0
VASC	1	1	2	+	+	+	1	+	+	+	+	+	+	+	1	+	r	1	2	+	1	1	1	r	1	+	+	1	r	1
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	r	0	r	r	r	r	0	r	r	r	r	r	0	r	0	r	r	0	+	r	r	r
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	+	0	r	+	1	r	r	+	1	1	1	+	+	r	+	+	r	r	0	0	r	r	r	r	+	+	r	0	0	r
EPAN	0	0	0	0	0	0	0	0	r	r	r	r	0	r	r	r	0	r	r	0	0	0	0	0	0	r	0	r	r	0
EMNI	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
GOOB	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	r	r	0	r	r	0	0	0	0	r	r	r	r	r	r	0	r	r	r	r	r	0	0	r	0	0	r	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	r	+	r	r	r	r	r	r	r	0	r	r	r	+	r	+	r	r	r	0	0	0	0	0	0	0	0	0	r
HYSP	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	1	0	0	0	+	0	0	0	0	0	0	0	0	0	0
PLSC	1	2	+	1	+	+	1	2	r	1	2	+	r	+	+	+	r	r	+	1	2	2	2	2	+	r	+	+	+	+
POJU	r	r	r	0	r	r	0	r	r	0	r	r	r	r	r	r	r	0	0	r	0	r	0	r	r	r	r	+	r	+
PTCR	0	0	0	0	r	r	r	+	0	0	r	0	0	0	r	r	0	r	0	0	r	0	0	r	r	0	r	0	0	+
CLADONIA	1	1	2	+	+	r	1	r	1	+	r	+	+	+	r	+	+	+	+	1	1	+	+	r	r	r	+	+	+	+
PELT.	r	r	r	+	+	1	1	+	+	r	r	r	1	+	+	r	r	1	+	r	r	1	+	+	r	+	+	+	+	0
STEREO.	r	r	r	r	+	r	0	0	+	0	0	r	r	r	r	r	r	0	0	0	0	0	0	0	0	0	r	0	0	0

Table B-7. Continued (Hector understorey 1967).

Species	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
SHCA	2	1	1	0	1	1	3	+	+	+	2	+	2	1	1	3	1	+	2	2	3	3	1	1	r	+	0	0	0	1
LEGR	+	r	0	0	0	0	0	r	r	r	0	0	r	0	0	0	+	0	0	0	0	0	0	r	1	r	r	0	0	0
MEFE	4	2	3	3	2	2	1	3	3	3	4	4	3	4	3	1	4	5	3	2	2	2	3	4	5	3	3	4	4	2
RHAL	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	0	0	r	r	+	r	r	0	+	r	r	r	r	r	r	0	+	+	+	r	r	r	r	r	0	0	0
VAMY	+	r	+	+	+	1	+	r	r	r	+	r	+	1	r	+	+	1	+	0	0	r	r	0	+	r	r	0	0	r
VASC	+	1	+	+	1	+	r	1	+	2	+	r	+	+	+	r	+	r	1	2	1	+	+	r	r	r	+	2	1	2
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	r	r	+	r	r	r	r	r	r	0	0	0	0	r	r	0	r	r	r	r	+	+	r	r	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	r	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	r	+	+	+	r	0	r	r	r	r	+	+	1	+	r	+	r	1	+	+	r	0	r	+	+	r	r	+	+	+
EPAN	+	r	0	0	0	0	0	0	0	r	0	r	r	0	0	r	0	r	r	0	0	r	r	r	0	r	r	r	r	r
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	r	0	0	0	r	0	r	r	r	r	r	0	0	0	0	0	r	0	r	0	r	0	0	r	r	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	r	r	0	r	0	0	0	r	0	0	0	0	r	0	0	r	r	0	0	0	r	0	r	0	r	0	r	0	0
HYSP	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	1	1	1	1	1	1	1	2	3	1	2	+	2	1	+	+	2	+	+	+	+	0	1	1	2	+	r	1	+	+
POJU	0	0	r	0	r	0	r	r	0	0	r	+	r	+	r	1	+	+	0	0	+	+	1	1	+	+	+	+	+	+
PTCR	r	0	0	r	+	r	+	r	0	r	0	0	0	0	0	r	r	r	r	r	0	0	r	0	r	r	r	0	+	0
CLADONIA	+	1	1	r	1	1	r	+	1	1	r	+	+	+	1	+	r	1	1	1	1	1	2	1	+	1	+	+	1	+
PELT.	+	r	r	1	1	r	+	+	+	0	r	+	r	+	r	1	+	+	0	0	+	+	1	1	+	+	+	+	+	+
STEREO.	0	r	0	0	0	+	0	0	0	+	r	r	+	0	r	r	0	0	r	r	0	r	0	0	0	+	r	0	0	0

Species	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
SHCA	1	1	0	1	0	1	2	2	1	+	+	+	1	2	2	+	3	+	3	2	+	0	+	2	1	0	+	2	r	2
LEGR	0	0	0	1	+	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	+	+	+	+	+	1	+	+	0	0
MEFE	2	4	3	3	4	4	4	3	5	3	5	3	4	1	2	4	3	2	2	1	4	4	5	5	4	4	4	4	4	5
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
LOIN	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	r
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	r	r	+	+	r	0	r	+	+	r	r	r	+	r	+	0	r	1	+	0	0	r	r	0	r	r	r	0	0	0
VAMY	+	r	1	1	+	1	1	1	+	r	2	2	1	1	+	1	1	r	+	1	+	r	0	0	r	+	+	1	1	1
VASC	+	r	1	1	+	1	1	1	2	2	2	2	1	1	+	1	1	r	+	1	+	1	1	r	+	+	1	+	1	1
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	r	r	0	0	0	0	r	0	r	0	r	r	r	r	r	r	0	0	0	0	0	0	r	r	r	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
ARCO	+	1	1	1	+	0	r	r	r	r	r	r	+	1	r	+	r	+	+	+	1	+	r	0	r	r	r	+	r	r
EPAN	r	r	r	r	r	r	r	r	r	0	0	r	r	0	r	0	r	r	r	0	0	r	r	0	0	r	0	0	0	r
EMNI	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	r	r	0	r	r	0	r	0	r	r	r	r	0	0	r	r	r	r	0	r	0	0	0	0	r	0	0	r
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	r	0	0	0	0	0	0	+	0	0	r	0	0	0
HYSP	0	0	0	+	+	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	r	2	1	1	2	2	2	1	+	+	2	2	2	+	1	+	r	1	2	1	1	1	+	+	2	1	1	1	2	3
POJU	r	0	r	0	0	r	0	r	r	+	+	0	r	r	0	r	r	r	r	+	0	r	r	0	+	0	0	r	0	0
PTCR	r	+	0	r	+	r	r	+	r	r	+	+	+	r	0	0	0	+	r	0	r	r	0	0	r	+	r	r	r	r
CLADONIA	1	+	r	1	1	1	+	1	1	+	1	1	+	+	1	1	+	1	+	1	+	+	r	r	1	+	+	r	+	r
PELT.	+	r	1	2	2	+	1	0	1	+	+	+	+	+	r	r	+	+	+	+	0	+	+	r	+	+	1	+	r	+
STEREO.	0	0	0	r	0	0	0	0	0	0	r	r	+	+	0	0	r	r	r	+	0	r	0	0	0	0	0	0	0	r

Species	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
SHCA	3	0	1	0	+	2	1	2	1	+	3	3	+	0	2	2	0	1	3	2	1	0	0	1	r	+	r	+	0	+
LEGR	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	r	+	0	0	0	0	r	+	+	+	+	+	r	r	+
MEFE	3	4	3	4	2	1	1	0	2	+	0	0	0	0	0	1	3	2	2	2	5	5	4	5	5	4	5	5	4	4
RHAL	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	+	0	0	0
LOIN	0	0	0	0	0	0	r	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
SPBE	0	0	0	0	0	0	0	0	0	r	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
RILA	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	r	0	+	+	0	+	+	+	1	1	+	r	r	+	+	r	r	r	0	0	0	r	0	0	0	0	0	r
VAMY	0	1	+	0	0	0	0	0	0	0	0	0	0	r	r	+	0	0	0	r	+	1	1	r	r	0	0	+	+	r
VASC	1	+	+	+	1	+	1	1	2	+	1	1	1	2	2	+	1	+	2	2	1	1	+	1	+	+	+	+	1	1
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	r	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	r	r	r	r	r	0	0	0	0	0	0	r
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	+	r	r	r	r	+	+	+	+	r	1	+	+	+	r	r	r	r	+	+	r	r	r	+	+	+	r	r	+	+
EPAN	r	0	0	0	r	r	r	r	r	r	0	r	r	r	0	r	0	0	r	r	r	r	0	r	0	0	0	r	0	r
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	r
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	r	0	r	r	r	0	r	r	r	r	r	r	0	0	r	r	r	r	0	r	0	0	0	0	0	0	0	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	1	1	1	r	+	1	r	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	1	1	+	2	2	1	2	1
POJU	r	0	r	r	r	0	r	0	0	0	0	0	0	0	r	0	r	+	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	+	0	0	0	0	0	0	0	0	0
CLADONIA	+	+	1	r	1	+	1	+	+	r	0	r	1	1	r	+	1	2	1	1	r	+	+	1	1	r	r	+	+	+
PELT.	+	r	1	1	+	+	+	+	r	r	0	r	+	1	+	+	1	+	+	0	r	0	r	0	r	0	r	0	r	r
STEREO.	0	0	0	0	r	0	r	r	r	r	r	r	r	r	r	r	r	0	r	0	0	0	0	0	0	0	0	0	1	+

Table B-7. Continued (Hector understorey 1967).

Species	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
SHCA	0	2	+	2	3	r	r	0	2	3	3	4	1	1	2	2	3	2	2	2	0	0	r	0	+	3	2	0	2	1
LEGR	r	0	r	r	+	+	+	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	5	3	5	4	4	5	5	4	4	3	1	+	1	2	1	0	0	0	0	0	2	0	r	0	0	2	0	+	3	1
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	r	0	0	0	0	r	0	0	0	0	0
SPBE	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	1	+	0	r	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	r	0	0	0	0	0	0	0	+	+	1	r	+	+	r	+	r	1	r	r	r	r	r	0	0	0	0	0
VAMY	+	+	+	r	0	r	r	1	1	+	0	0	r	1	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	+	1	r	1	1	+	1	1	+	1	r	+	+	1	+	1	1	1	3	+	r	2	1	1	1	1	2	+	2	1
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	r	r	+	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	r	r
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r
ARCO	r	r	+	+	+	+	+	+	+	+	+	+	+	r	r	+	+	r	+	+	r	r	0	0	r	+	r	r	r	+
EPAN	0	0	r	r	r	0	0	r	r	0	r	r	r	r	r	r	0	r	0	0	r	0	0	r	r	r	0	0	r	r
EMNI	0	0	0	0	r	r	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	r	0	r	0	0	0	r	0	r	r	0	0	r	r	r	0	r	0	0	0	0	r	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYSP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	1	1	2	1	r	+	2	r	r	2	r	r	r	1	+	+	+	0	0	0	0	0	0	0	0	0	+	r	+	3
POJU	r	r	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	r	0	0	r	r	0	r	r	r	r	0	r	r
PTCR	r	0	+	+	0	+	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r
CLADONIA	+	1	r	2	+	+	1	+	r	+	1	1	+	+	r	+	+	1	0	0	0	0	r	r	+	+	+	+	+	1
PELT.	0	0	0	0	0	0	0	+	+	0	0	0	r	+	0	r	0	r	r	0	+	0	0	+	+	+	1	0	+	+
STEREO.	+	+	0	0	r	0	0	r	0	r	r	+	+	r	0	0	+	0	r	0	r	r	0	+	+	r	r	+	+	+

Species	391	392	393	394	395	396	397	398	399	400
SHCA	2	+	2	+	0	0	1	1	r	1
LEGR	0	+	+	+	+	r	r	r	0	0
MEFE	4	5	4	5	4	4	4	5	5	4
RHAL	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	r	+	r	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	r
RILA	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	0	0	0	0	0	0	0
VAMY	0	0	0	+	+	+	1	r	+	+
VASC	3	+	1	1	+	+	+	+	1	1
FRVI	0	0	0	0	0	0	0	0	0	0
ORSE	+	0	r	r	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0
COCA	0	r	0	0	0	0	0	0	0	0
ARCO	+	+	+	1	+	+	+	+	r	r
EPAN	r	r	r	r	0	r	r	0	0	0
EMNI	0	0	r	0	0	0	+	0	0	0
GOOB	0	0	0	0	0	0	0	0	0	0
LICO	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	r	0	0	r	0
LYAN	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0
HYSP	0	0	0	0	0	0	0	0	0	0
PLSC	2	2	5	3	4	4	3	1	2	2
POJU	r	0	0	0	0	0	0	r	r	+
PTCR	+	r	0	0	0	+	r	0	0	r
CLADONIA	+	r	r	r	+	+	+	r	+	r
PELT.	+	+	+	r	+	r	0	0	+	0
STEREO.	0	0	0	0	r	0	r	r	0	0

Table B-8. Undestorey species cover estimates for Hector 1989.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SHCA	0	0	0	0	0	0	3	+	0	r	3	3	5	6	6	3	2	0	5	0	0	0	0	0	0	4	2	4	+	0
LEGR	+	4	4	+	+	2	+	0	r	+	r	r	r	0	r	+	2	+	+	r	2	+	+	r	r	0	0	r	0	r
MEFE	38	36	40	30	40	44	26	32	36	40	50	34	28	12	18	42	26	38	46	46	28	56	34	28	36	24	34	26	34	38
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	+	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	0	r	r	0	r	0	+	0	0	+	+	2	0	0	0	0	0	0	0	0	0	0	r	0	r	r	0
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	2	r	+	3	2	4	4	4	4	4	4	4	5	4	4	3	2	4	3	5	4	3	2	+	2	5	2	2	3	3
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	r	+	r	r	2	+	0	0	0	0	+	+	+	2	0	0	0	0	0	0	0	0	3	+	+	+	0	+
ARCO	0	0	r	2	0	r	+	+	0	+	r	2	+	2	2	+	r	r	+	r	0	r	2	2	+	r	+	2	2	2
ASCI	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	r	r	r	0	0	0	0	r
EMNI	0	0	0	0	0	0	0	r	0	0	r	r	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	r	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	2	+	2	2	3	r	r	+	+	2	+	r	r	+	+	+	r	+	r	r	+	+	+	+	2	2	r	+	+	+
HYSP	12	5	4	2	2	+	+	r	0	0	0	0	0	+	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	52	44	40	58	35	30	47	43	29	40	41	49	48	42	50	42	45	48	38	42	41	40	57	55	52	30	41	34	39	53
POJU	0	r	r	0	0	r	0	r	0	r	r	r	r	r	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
PTCR	2	2	0	+	+	0	2	+	+	+	0	0	+	+	0	0	+	r	r	0	0	0	0	0	0	0	0	r	0	0
CLADINA	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
CLADONIA	r	r	+	r	r	r	+	+	r	+	+	+	r	+	+	+	+	+	r	r	+	r	r	r	r	+	r	r	r	r
PELT.	+	2	2	2	+	2	2	+	r	r	+	+	+	+	+	+	+	+	+	r	r	+	r	+	r	r	+	r	r	r
STEREO.	0	0	0	r	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0

Species	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
SHCA	+	0	+	0	0	+	0	+	0	0	0	0	0	0	0	0	0	0	+	0	3	0	0	2	0	7	0	3	0	0
LEGR	2	0	r	+	+	+	2	+	r	r	r	0	r	2	2	2	r	r	0	r	+	0	0	0	0	r	0	2	2	+
MEFE	34	34	36	30	34	34	32	44	32	20	20	30	36	36	40	40	38	46	32	32	48	44	36	20	34	34	24	22	36	34
RHAL	2	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	0	0	0	0	r	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	2	3	2	3	2	+	2	3	4	+	r	2	3	+	r	2	2	+	3	2	2	+	2	3	5	4	2	+	+	3
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	+	+	2	+	+	r	+	+	+	0	0	+	2	2	+	+	3	2	2	+	r	r	0	r	r	r	0	0	0	0
ARCO	0	r	r	r	+	+	+	r	0	+	r	3	+	2	+	+	+	+	r	2	2	2	+	2	2	2	0	2	0	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	r	r	r	0	r	0	r	r	0	0	r	0	0	0	0	r	0	r	0	r	0	0	0	0	0	0	0	0	0
EMNI	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
DIUN	+	2	2	+	2	2	r	+	+	+	+	r	+	+	+	r	+	+	r	r	r	r	+	+	+	+	+	r	+	r
HYSP	0	0	0	0	0	0	2	2	2	+	+	2	0	2	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	45	42	30	37	30	62	36	43	40	59	44	61	51	45	55	51	58	41	53	53	50	38	28	38	41	51	58	60	39	52
POJU	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	r	0	0
PTCR	r	r	0	0	0	r	0	0	0	r	0	r	0	2	0	0	0	0	0	+	0	r	0	+	+	0	r	r	0	r
CLADINA	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADONIA	r	r	+	r	+	+	+	+	+	r	r	r	+	r	r	r	r	r	+	r	r	r	r	+	r	r	r	r	r	r
PELT.	r	r	r	2	2	r	2	+	r	2	2	+	3	3	2	2	+	2	+	2	+	2	r	2	+	r	+	+	r	r
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0

Table B-8. Continued (Hector understorey 1989).

Species	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
SHCA	0	0	+	0	2	0	5	0	0	2	5	+	3	0	+	0	0	0	+	0	0	+	+	2	7	4	+	0	0	3
LEGR	+	r	r	0	r	0	0	r	0	0	0	0	+	+	+	r	r	r	r	0	r	r	0	0	0	0	0	0	0	0
MEPE	26	28	28	24	42	32	20	44	36	52	16	22	28	48	28	24	24	34	20	30	24	30	16	34	34	10	14	42	46	28
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	0	0	0	0	0	r	r	+	0	r	0	0	0	0	2	+	0	r	+	r	+	2	2	2	+	r	r
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	+	4	2	2	2	3	4	3	2	+	2	3	+	2	2	r	r	r	2	+	2	+	r	r	r	r	2	2	r	r
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	r	+	r	0	0	0	0	r	+	2	2	2	2	r	0	r	+	r	0	0	r	r	2	+	0	r	+	r	0
ARCO	0	r	+	2	2	+	+	2	+	+	+	2	+	r	0	+	r	+	+	r	2	r	+	+	+	+	0	+	+	2
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	r	0	r	0	0	0	0	r	0	0	0	r	r	0	0	0	0	0	0	0	r	r	r	0
EMNI	0	0	0	0	0	0	0	0	0	0	0	r	r	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	r	+	+	2	2	r	+	+	+	2	+	+	+	+	+	+	2	+	r	+	r	+	2	+	r	+	+	+	r	+
HYSP	0	0	r	0	2	+	r	0	r	+	+	3	+	r	r	+	2	r	+	r	0	0	+	4	0	2	0	0	0	0
PLSC	40	54	46	46	55	40	49	58	51	39	43	58	55	48	59	29	31	48	62	66	29	25	19	18	36	34	17	39	35	51
POJU	0	0	r	0	0	r	+	0	r	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	+	r	r	r	0	r
PTCR	0	0	0	r	+	r	r	+	2	2	3	+	2	+	+	+	+	r	r	r	0	0	0	0	r	0	0	r	+	r
CLADINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	r	0	0	0	0
CLADONIA	r	r	r	r	r	r	+	r	r	r	+	r	r	r	+	+	+	r	r	r	r	r	+	r	r	r	+	+	r	r
PELT.	r	r	+	+	r	r	r	r	2	+	2	+	+	+	+	2	4	2	+	+	r	2	2	2	+	2	+	2	+	r
STEREO.	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	0

Species	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
SHCA	3	2	0	0	r	r	3	2	+	r	8	3	2	6	6	8	+	0	3	2	0	+	2	7	12	4	4	0	r	0
LEGR	0	r	0	r	+	r	r	r	r	+	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0
MEPE	26	32	36	34	38	34	30	22	38	42	16	24	24	4	14	28	38	36	28	32	34	28	44	2	6	38	20	14	32	46
RHAL	0	0	0	0	0	0	0	0	+	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	r	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	+	+	0	0	0	0	+	r	0	0	+	+	0	2	2	r	r	0	0	0	r	+	r	+	+	r	r	r	r	0
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VASC	2	+	2	2	r	2	2	3	3	3	2	2	3	2	5	+	+	+	+	2	2	r	2	+	+	r	r	r	+	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	+	+	2	r	+	2	+	3	+	+	0	0	0	0	0	0	0	0	r	+	r	2	0	0	0
ARCO	3	2	2	2	+	2	3	4	+	3	2	2	2	3	4	2	+	2	2	+	+	+	0	+	+	r	+	r	r	0
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	r	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	+	r	+	r	+	+	+	+	+	+	r	+	+	+	+	r	+	r	2	+	r	+	r	2	+	+	+	r	r	r
HYSP	0	0	0	0	0	0	2	0	0	0	0	2	r	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	53	52	28	55	31	46	38	42	44	52	31	27	41	35	42	39	43	39	44	54	54	26	46	15	13	31	17	2	29	47
POJU	0	r	r	0	0	r	0	r	0	0	0	r	0	0	r	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0
PTCR	+	0	+	r	+	0	+	+	+	r	r	r	+	+	+	r	+	+	+	r	+	r	2	0	r	+	+	r	0	0
CLADINA	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0
CLADONIA	r	r	r	r	r	r	+	r	r	r	r	r	r	r	+	r	r	r	r	r	r	+	r	+	+	r	r	r	r	r
PELT.	r	r	2	+	r	+	r	r	r	r	+	+	2	+	r	r	r	+	+	r	r	r	r	2	r	+	2	2	2	r
STEREO.	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0

Table B-8. Continued (Hector understorey 1989).

Species	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
SHCA	0	4	3	4	4	2	3	+	2	r	0	3	r	+	2	4	2	+	2	+	5	3	2	+	0	2	+	2	+	3
LEGR	0	0	0	0	0	0	r	0	r	r	0	r	r	0	0	r	0	0	0	0	0	0	r	r	2	+	r	0	0	0
MEFE	30	32	18	14	30	32	40	30	24	14	14	22	26	34	30	38	22	22	8	18	10	12	18	22	52	34	32	28	12	24
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0
JUCO	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	r	+	r	r	r	0	0	r	r	r	+	+	+	+	r	+	+	+	2	+	+	r	0	r	+	+	+	3
VAMY	0	0	0	0	0	0	0	0	0	0	0	0	r	0	r	r	r	0	0	0	0	0	0	+	r	r	0	r	0	0
VASC	2	+	+	+	r	+	+	+	r	3	2	+	+	2	+	2	+	2	3	3	3	+	+	2	r	r	3	+	+	r
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	r	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	+	+	r	0	0	0	0	0	0	0	0	0	r	2	3	2	2	+	+	+	0	0	0	0	0	0	0
ARCO	+	0	r	r	r	r	r	+	+	+	+	2	2	2	2	2	r	2	2	2	2	+	r	+	0	+	+	3	+	2
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	r	0	0	r	r
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	r	+	r	+	r	+	+	+	+	+	+	r	+	r	r	r	r	+	+	+	+	r	+	+	+	+	+	+	+	+
HYSP	0	0	0	0	0	r	+	+	r	r	0	+	0	0	0	0	+	0	0	0	r	r	r	0	r	0	0	0	0	+
PLSC	13	28	2	16	10	43	39	35	40	12	20	52	44	40	18	37	36	33	16	22	10	21	27	38	41	30	36	48	33	29
POJU	0	0	0	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	r	0	0
PTCR	+	+	r	r	r	r	0	0	r	+	0	+	+	r	r	+	r	0	+	+	0	+	r	0	r	0	0	0	0	r
CLADINA	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0
CLADONIA	r	+	r	+	+	r	r	r	r	+	+	r	r	r	r	r	r	r	r	r	r	r	+	r	r	r	+	r	r	+
PELT.	+	r	+	2	+	+	r	+	+	r	2	+	r	+	+	+	+	+	+	r	r	+	2	+	r	r	r	r	r	r
STEREO.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
SHCA	4	0	0	0	0	5	5	2	r	0	0	4	2	5	7	4	2	0	6	7	+	4	8	3	+	0	0	0	2	0
LEGR	r	r	+	r	0	0	r	r	r	r	+	r	r	0	0	0	0	r	0	0	0	0	r	r	+	2	r	r	0	0
MEFE	16	26	28	30	26	14	22	42	48	34	26	22	40	30	10	14	36	40	22	14	20	30	16	36	36	48	30	16	20	36
RHAL	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	r	0	0	0	0	+	r	0	0	0	0	0	0	r	0	0	r	r	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	r	r	0	0	r	r	+	r	0	0	0	0	0	r	r	+	r	r	r	+	2	2	2	r	r	r	r	+	2	0
VAMY	0	0	+	r	0	0	r	0	0	r	0	0	r	r	+	0	+	3	+	r	0	0	0	r	r	0	r	r	0	0
VASC	r	r	+	2	r	r	2	2	r	2	+	2	+	+	2	2	2	5	2	+	+	2	2	2	+	r	+	+	3	2
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	r	2	2
ARCO	+	r	r	r	r	0	r	+	+	+	+	r	+	+	0	r	0	r	+	+	+	+	2	2	+	0	+	+	2	+
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	+	r	+	r	r	r	r	+	+	r	2	0	2	r	r	+	+	+	r	+	+	r	r	r	r	+	+	+	+	+
HYSP	0	0	0	0	0	2	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+
PLSC	31	28	36	43	46	8	32	28	40	51	37	17	46	23	32	3	35	45	41	13	8	13	29	55	53	42	38	6	20	24
POJU	r	0	0	0	r	r	r	r	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0	r	0
PTCR	r	0	+	0	0	0	0	0	0	r	+	0	0	r	0	0	0	0	0	0	0	r	r	+	r	r	0	0	0	0
CLADINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADONIA	+	+	r	r	r	+	+	r	r	r	r	+	r	r	r	r	r	r	r	r	r	r	+	r	r	r	r	2	r	r
PELT.	+	+	r	r	r	2	+	r	r	r	r	+	+	2	+	2	+	r	+	+	+	r	r	+	r	r	r	+	+	+
STEREO.	0	0	0	0	0	0	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0

Table B-8. Continued (Hector understorey 1989).

Species	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
SNCA	+	r	+	0	0	3	4	5	2	5	7	0	2	r	2	2	2	4	4	0	+	2	+	2	r	+	0	+	2	0
LEGR	0	0	r	0	r	r	0	+	+	0	0	0	0	r	r	0	r	r	+	+	+	r	r	r	0	r	0	r	0	r
MEPE	40	28	34	38	28	18	18	22	40	24	20	34	34	26	16	22	10	18	20	32	30	40	44	34	26	36	30	34	20	42
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
SPBE	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	r	r	+	r	r	r	r	+	r	+	+	r	r	r	r	+	+	r	0	0	0	0	0	r	0	r	0	r	r	r
VAMY	0	0	0	r	+	r	r	r	r	r	+	+	r	0	r	r	2	r	0	r	+	r	r	+	0	0	0	+	0	r
VASC	2	+	2	2	4	3	2	3	2	2	4	2	+	+	2	+	3	2	+	+	2	2	+	2	2	+	+	2	+	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	+	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0	r	+	0
PYCH	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	2	+	+	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	+	2	+	2	+	+	+	2	2	2	+	+	+	r	r	+	r	r	r	0	0	r	r	r	r	r	r	+	2	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
EMNI	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	+	+	+	+	r	r	r	r	r	r	+	+	r	+	+	+	+	+	+	r	+	+	+	r	+	r	+	r	+	+
HYSP	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLSC	36	31	23	39	27	29	37	57	22	38	45	44	56	58	33	26	50	48	40	59	58	48	50	42	47	52	46	41	54	42
POJU	r	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0
PTCR	r	r	r	r	r	r	0	+	r	r	0	0	0	0	+	r	+	0	r	r	0	+	r	r	r	0	r	r	+	0
CLADINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADONIA	r	r	+	r	+	r	+	r	r	r	+	r	r	r	r	r	+	r	r	r	r	r	r	+	r	r	r	r	r	r
PELT.	+	r	r	+	2	+	+	+	+	+	+	+	r	+	+	2	+	+	+	r	+	+	+	+	+	+	+	+	r	r
STEREO.	0	0	0	r	r	0	r	0	0	0	0	0	0	r	r	r	r	0	0	r	0	0	0	0	0	0	0	0	0	0

Species	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
SNCA	2	0	2	4	5	2	2	r	4	2	2	4	4	7	5	+	+	2	0	2	+	+	0	0	4	+	0	0	0	+
LEGR	r	0	0	0	0	0	0	0	0	0	0	r	0	0	0	+	0	0	0	2	+	0	0	0	0	r	+	r	r	r
MEPE	34	28	24	34	14	28	10	4	10	28	18	10	1	10	18	24	32	42	30	16	20	6	12	24	20	32	42	38	36	30
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	+	r	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	r	r	r	r	+	2	+	+	r	r	+	2	+	+	r	+	r	0	+	2	r	+	+	r	r	r	0	0	0	0
VAMY	r	+	r	r	0	+	+	0	r	r	0	0	0	0	r	0	0	+	0	0	r	r	r	0	r	0	0	r	r	r
VASC	+	2	5	2	2	+	2	2	+	2	+	2	+	2	+	+	+	2	+	2	+	2	2	+	+	+	r	2	+	+
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	r	0	+	+	0	0	0	r	r	r	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	r	+	+	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	2	+	+	r	+	2	2	r	+	+	+	r	r	+	+	r	+	+	2	2	2	+	2	2	3	2	+	+	r	+
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	r	r	0	0	0	r	0	0	0	0	0	0	0	r	0	r	0	0	0	0	r	0	r	0	0	0	r	0	r
EMNI	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0
DIUN	+	r	r	+	2	r	r	+	+	+	+	r	+	r	0	+	+	+	r	r	r	r	r	0	r	r	r	r	r	r
HYSP	0	0	0	0	r	r	r	0	+	0	r	0	r	0	r	r	r	0	0	r	0	0	+	0	0	0	0	0	0	0
PLSC	44	47	42	43	22	28	35	21	32	29	20	33	18	24	45	43	28	37	26	43	58	39	52	65	53	40	38	41	50	38
POJU	+	0	0	0	0	r	r	r	0	r	r	0	r	0	0	r	0	0	r	r	r	0	0	r	0	0	0	0	0	0
PTCR	0	+	r	+	+	r	+	0	r	0	r	0	+	0	r	r	+	+	0	0	r	0	r	+	+	r	0	0	r	r
CLADINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
CLADONIA	r	r	r	r	+	r	r	r	r	r	r	+	+	r	r	r	r	r	r	r	r	+	r	r	r	r	r	r	r	r
PELT.	r	r	r	+	2	+	+	+	r	+	+	+	2	+	r	2	+	2	+	+	+	2	+	+	r	+	+	r	r	r
STEREO.	0	0	0	0	0	r	0	0	r	r	0	0	0	r	r	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0

Table B-8. Continued (Hector understorey 1989).

Species	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
SHCA	+	4	5	3	4	+	r	0	2	2	2	3	6	2	2	3	5	6	5	0	0	0	+	0	+	5	7	2	5	2
LEGR	+	+	0	0	0	0	0	+	0	r	r	0	0	0	0	0	0	0	+	+	r	r	r	r	r	r	0	0	r	r
MEFE	30	24	22	10	16	18	18	20	12	26	26	30	20	18	10	6	6	12	14	26	26	32	26	36	22	12	1	14	44	60
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0	0	0	0	0	0	0	0	0	r	0	r	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	0	r	+	0	0	0	+	+	+	+	+	+	2	r	+	+	r	r	0	r	r	r	2	+	+	r	+	r
VAMY	r	+	0	r	r	r	r	r	r	0	0	r	r	0	0	0	r	0	0	0	r	0	0	r	0	0	0	r	r	0
VASC	2	3	3	r	+	r	+	+	+	2	+	+	+	r	r	+	+	2	2	+	+	r	2	r	r	r	r	r	+	r
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	r	0	r	r	r	r	0	r	r	r	r	r	0	r	r	0	r	0	r	r	0	r
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	+	0	0	+	2	+	+	+	2	+	2	+	r	+	+	+	r	r	r	r	+	+	r	0	+	r	r	r	0	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	0	0	0	0	0	.0	r	r	r	r	0	r	0	r	0	r	r	0	0	r	0	0	0	r	0	0	r	0
EMNI	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUM	r	r	r	r	0	r	r	+	r	r	+	+	+	+	+	+	+	r	+	r	+	+	+	+	r	r	+	r	r	0
HYSP	0	0	0	+	0	r	+	r	0	0	0	r	0	0	0	5	2	0	+	+	0	0	0	0	0	0	+	0	0	0
PLSC	41	46	27	30	18	25	51	54	28	39	32	29	16	21	16	13	25	37	22	35	40	42	37	35	21	21	49	16	5	32
POJU	0	0	r	0	r	0	0	0	r	0	0	0	r	0	r	0	r	0	0	0	r	0	0	r	0	0	r	+	0	r
PTCR	0	0	0	r	+	+	r	r	r	+	0	r	0	r	r	0	r	2	r	0	0	0	0	2	r	r	r	0	0	r
CLADINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADONIA	r	+	r	r	r	r	r	r	+	r	r	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
PELT.	r	r	r	r	2	2	2	+	+	r	r	+	+	+	+	+	+	2	+	+	r	+	+	+	2	+	+	3	+	+
STERBO.	0	r	r	0	0	0	0	0	r	0	0	r	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	r	0

Species	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
SHCA	3	5	2	0	4	4	7	2	3	4	+	+	4	+	3	4	2	r	2	7	7	6	3	5	r	3	+	0	+	3
LEGR	r	r	0	0	0	0	0	0	0	r	r	r	r	0	0	0	r	0	0	0	0	0	0	r	+	0	r	0	0	0
MEFE	32	16	20	24	16	16	10	18	22	10	28	20	14	40	12	12	30	42	18	12	12	10	24	16	38	18	14	34	22	10
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	r	r	0	0	r	r	0	0	0	r	r	+	r	0	r	r	r	r	0	r	+	2	3	r	r	r	r	r	r	r
VAMY	r	0	r	r	0	+	+	r	r	r	r	0	r	+	0	r	r	+	+	0	r	0	r	r	r	r	0	0	0	r
VASC	r	2	+	+	+	+	+	r	+	+	r	r	+	2	r	+	+	2	3	3	+	+	+	r	r	+	+	2	+	2
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	r	0	r	0	r	r	r	0	r	r	0	0	0	0	r	r	r	0	0	r	0	r	r	r	r	r	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	+	+	r	0	+	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	r	+	r	+	r	0	r	r	r	+	r	2	2	+	+	2	+	+	+	2	0	r	0	r	r	+	+	+	+	+
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	r	0	0	0	0	0	0	0	0	r	0	r	r	r	0	0	0	0	r	r	0	0	r	0	0	0	r	r	r	r
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUM	r	r	r	r	+	r	r	r	r	r	r	r	r	r	0	r	r	r	+	r	r	+	+	0	r	r	+	+	+	+
HYSP	0	2	2	0	+	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	+
PLSC	17	29	54	47	46	42	43	53	51	41	39	45	43	38	26	22	30	43	31	37	14	16	26	30	47	29	+	25	27	8
POJU	r	0	r	0	r	0	r	r	r	0	0	r	0	0	0	0	0	0	r	0	0	0	r	0	0	0	0	r	r	r
PTCR	0	+	r	r	+	0	r	0	0	+	0	0	0	r	0	r	0	0	0	r	r	r	r	r	r	r	0	0	+	r
CLADINA	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADONIA	r	r	r	r	r	r	r	r	r	+	r	r	r	r	+	r	r	r	r	r	r	+	r	r	r	+	r	r	r	r
PELT.	+	+	+	+	2	+	+	+	r	+	r	r	+	r	r	+	+	r	r	r	+	+	2	+	r	+	3	+	+	2
STERBO.	0	0	0	0	0	r	0	0	r	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r	0

Table B-8. Continued (Hector understorey 1989).

Species	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
SHCA	2	2	2	+	+	2	3	3	2	2	0	0	+	5	5	3	3	2	5	5	2	0	0	2	2	0	0	3	+	2
LEGR	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	+	+	r	r	0	0
MEPE	10	32	14	18	26	22	24	10	26	22	32	22	18	4	8	18	28	10	10	10	22	20	16	24	26	30	26	30	30	24
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	r	r	+	+	r	0	+	+	r	r	0	0	+	r	+	r	0	2	+	0	0	0	r	0	0	0	r	r	0	0
VAMY	0	r	0	r	r	0	r	r	r	r	0	r	r	0	r	r	r	+	0	r	r	0	0	r	r	r	+	r	r	r
VASC	+	r	+	r	r	r	r	+	+	+	+	+	r	+	r	0.2	2	3	+	+	+	r	r	r	r	r	2	+	+	r
PRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	0	0	0	r	r	r	0	0	r	r	0	0	0	r	0	0	0	r	r	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	r	0	r	+	r	0	0	0	0	0	0	0	0	0
ARCO	+	+	2	+	r	+	r	r	+	r	r	+	+	+	r	+	+	2	+	+	+	r	r	0	r	r	0	+	r	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	r	r	r	0	0	0	0	r	0	0	0	r	0	r	r	0	0	r	r	0	r	r	r	0	0	0	0	0	0	0
EMNI	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	r	r	+	+	r	+	+	r	r	r	r	r	r	r	r	r	+	r	r	r	r	r	+	+	r	r	r	r	r	r
HYSP	0	0	r	2	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0
PLSC	3	32	7	34	43	39	47	31	28	25	39	46	35	19	12	31	28	40	39	35	31	30	27	28	43	40	40	47	53	53
POJU	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	0	0	0	0
PTCR	+	+	r	r	0	0	0	0	r	0	+	+	+	r	r	0	0	r	0	0	0	0	0	0	r	r	r	r	r	r
CLADINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLADONIA	+	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r
PELT.	2	+	+	2	2	+	+	r	2	3	r	+	r	+	r	r	+	+	+	r	r	+	+	r	r	r	r	+	+	r
STEREO.	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0

Species	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
SHCA	+	r	2	+	2	4	+	5	2	+	9	7	+	r	3	3	3	4	7	4	3	0	2	2	r	2	0	2	0	0
LEGR	0	0	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	r	+	r	+	+	+	r	r	+
MEPE	34	40	30	22	10	4	4	0.2	8	1	0	0	0	0	0	12	26	16	10	12	38	42	32	36	40	24	28	30	34	22
RHAL	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	2	+	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0
SPBE	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	r	r	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIBO	0	0	r	0	r	+	r	+	2	+	3	3	2	r	r	r	+	r	2	r	r	0	0	r	0	0	0	0	0	0
VAMY	r	r	+	r	r	0	r	0	r	0	0	0	0	+	0	+	+	r	r	r	+	+	2	0	0	0	r	r	r	r
VASC	r	+	+	r	+	r	+	+	r	r	r	r	r	+	r	2	+	+	r	+	+	+	2	+	r	r	+	+	+	2
PRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	r	r	0	r	0	0	0	0	0	r	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	r
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARCO	r	r	r	r	r	r	+	2	+	r	r	r	+	+	+	r	0	r	+	+	0	r	0	+	+	+	0	r	+	2
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	r	0	0	0	r	r	0	r	r	r	0	r	r	r	r	r	0	0	r	r	0	r	0	0	0	0	0	r	r	r
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	r	0	0	r	r	r	r	r	r	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	+	+	+	r	+	+	+	+	+	r	r	0	r	r	r	+	r	+	r	r	0	r	+	r	r	+	r	+	+	+
HYSP	r	0	0	0	0	2	+	0	0	0	+	0	0	0	0	0	0	0	r	0	r	+	0	0	r	0	0	0	0	0
PLSC	52	45	38	19	29	25	16	9	+	0	r	2	0	0	+	6	19	5	58	48	55	42	39	43	38	55	34	43	39	40
POJU	r	0	r	0	r	r	0	r	r	r	0	0	r	r	r	0	0	r	0	0	r	0	0	0	0	0	0	0	0	0
PTCR	+	r	0	0	0	r	0	r	0	0	0	0	0	0	r	0	0	0	0	0	+	+	+	r	r	+	r	0	r	0
CLADINA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0
CLADONIA	r	r	r	r	+	r	+	+	+	r	+	+	2	2	+	+	+	3	r	r	r	r	r	r	r	r	r	r	r	r
PELT.	+	r	r	+	+	+	2	+	2	+	+	+	+	2	3	+	2	+	+	+	+	r	r	+	+	+	r	r	r	r
STEREO.	0	0	0	0	r	0	r	0	0	0	0	r	r	0	r	0	r	r	0	0	0	0	0	0	0	0	0	0	r	r

Table B-8. Continued (Hector understorey 1989).

Species	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
SHCA	r	5	2	3	5	+	+	0	9	4	6	9	4	3	5	4	9	9	6	5	0	r	2	r	2	9	2	+	6	2
LEGR	r	0	r	r	r	r	+	+	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEFE	28	16	22	28	22	50	36	34	18	18	10	1	12	8	1	0	0	0	0	0	16	0	0.2	0	0	8	0.2	6	14	6
RHAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOIN	0	r	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	r	0	0	r	0	0	r	0	0	0	0	0
SPBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	2	+	r	r	0	0	0	0	0	0	0	0	0
SALIX	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RILA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0
LIBO	0	r	r	0	0	0	r	0	0	r	+	+	2	r	+	r	r	+	r	+	r	0	r	r	+	0	r	+	r	r
VAMY	r	r	r	r	0	r	r	r	+	r	0	0	r	+	0	0	0	0	0	0	0	r	0	0	0	2	3	0	r	0
VASC	+	+	r	r	+	r	2	+	2	+	r	r	+	2	r	r	r	r	+	r	r	2	r	2	+	2	3	r	r	r
FRVI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0
ORSE	0	0	0	0	0	0	0	0	r	r	r	0	0	0	0	0	0	0	0	r	0	0	0	0	0	r	0	r	0	r
PYCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	+	r
ARCO	r	+	r	+	+	r	+	r	r	r	+	+	+	r	+	r	0	0	r	r	0	r	r	0	0	r	0	r	+	r
ASCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	r	0	r	0	0	r	0	0	0	r	0	0	r	0	0	0	0	0	0	r	0	0	r	0	0	0	r	r
EMNI	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	r	r	r	r	r	0	0	0	r	r	r	0
LYAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIUN	+	r	+	r	r	r	+	r	r	r	0	r	r	r	+	2	r	r	0	r	+	0	r	+	r	+	+	+	+	+
HYSP	0	0	0	0	0	0	r	0	0	0	0	0	r	+	+	r	3	+	0	0	0	0	0	0	0	+	0	0	r	0
PLSC	31	43	51	49	36	46	36	48	27	49	52	39	22	3	30	6	2	+	0	r	+	0	0	0	0	7	10	9	28	58
POJU	0	r	0	0	0	0	0	0	0	0	r	0	0	0	r	0	0	0	r	r	r	r	+	r	r	0	r	0	r	0
PTCR	r	r	r	0	2	0	0	0	0	0	0	0	r	+	+	0	0	r	0	0	r	0	0	0	0	r	r	0	r	r
CLADINA	0	0	0	r	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	r	0	0	r
CLADONIA	r	r	r	r	r	r	r	r	r	r	r	+	+	+	r	r	r	r	r	r	r	+	r	+	+	+	+	+	r	r
PELT.	r	+	r	+	+	r	r	+	+	+	+	+	r	+	+	2	+	+	+	2	2	+	r	2	+	2	2	+	+	r
STEREO.	0	r	0	0	0	0	0	0	0	0	r	0	r	0	r	0	r	0	0	r	0	0	0	r	r	r	0	r	0	r

Species	391	392	393	394	395	396	397	398	399	400
SHCA	5	r	0	+	3	+	2	3	2	6
LEGR	0	r	+	r	r	r	r	0	0	r
MEFE	26	40	30	40	40	36	32	32	24	16
RHAL	0	0	0	0	0	0	0	0	0	0
LOIN	0	0	0	0	0	0	0	0	0	0
SPBE	0	0	0	r	r	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0
SALIX	0	r	0	0	0	0	0	0	r	0
RILA	0	0	0	0	0	0	0	0	0	0
LIBO	r	0	0	0	0	0	0	r	r	0
VAMY	0	r	r	r	0	0	+	0	r	r
VASC	+	r	+	r	r	r	2	r	r	+
FRVI	0	0	0	0	0	0	0	0	0	0
ORSE	r	0	0	0	0	0	0	0	0	0
PYCH	0	0	0	0	0	0	0	0	0	0
COCA	0	0	0	0	0	0	0	0	0	0
ARCO	r	r	r	+	+	+	+	+	r	+
ASCI	0	0	0	0	0	0	0	0	0	0
EPAN	0	0	r	0	r	r	0	0	0	0
EMNI	0	0	0	0	0	0	r	r	0	0
ELIN	0	0	0	0	0	0	0	0	0	0
CAREX	0	0	0	0	0	0	0	0	r	0
LYAN	0	0	0	0	0	0	0	0	0	0
LYCO	0	0	0	0	0	0	0	0	0	0
DIPO	0	0	0	0	0	0	0	0	0	0
DIUN	r	+	r	r	+	+	r	r	r	r
HYSP	0	0	0	r	0	0	0	0	0	0
PLSC	53	40	42	45	47	55	43	41	38	44
POJU	0	0	0	0	0	0	0	+	r	r
PTCR	r	+	0	+	0	r	0	0	0	0
CLADINA	0	0	0	0	0	0	r	0	0	0
CLADONIA	r	r	r	r	r	r	r	r	r	r
PELT.	+	r	r	+	+	r	+	r	+	r
STEREO.	0	0	0	0	0	0	0	0	r	r

Table B-9. Point cover estimates of understorey species at 25 stratified-randomly selected quadrats at Athabasca and Hector in 1967 and 1989. Note that 1967 estimates are recorded as Braun-Blanquet cover classes (see Chapter 3) whereas 1989 estimates are number of hits per 100 tries. One quadrat was not sampled at Hector in 1967. Quadrat order corresponds to N-S ordering of the 25 16-quadrat blocks the stratified random sample was based on.

1967 ATHABASCA	38	75	70	66	20	137	134	90	154	123	198	206	211	228	183	260	306	269	316	243	399	368	372	385	381
SHCA	0	2	0	8	0	2	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
JUCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	1	0	0	1
ARUV	29	20	5	30	8	32	25	30	20	43	18	34	36	12	54	28	32	24	23	47	5	42	38	34	54
ARUVC	5	2	0	4	2	18	4	4	5	16	1	3	5	4	4	3	8	7	4	12	0	0	0	0	0
LIBO	0	0	2	0	4	0	26	0	0	0	12	5	0	14	23	0	8	1	6	0	15	4	0	0	14
FRVI	4	4	3	1	4	1	4	1	3	1	0	1	2	1	0	0	3	0	0	0	2	1	0	2	4
ROAC	1	0	0	0	2	1	0	0	1	3	1	0	4	1	1	2	1	3	0	0	0	0	0	1	2
ELIN	3	9	5	2	10	10	0	9	5	3	3	5	5	4	8	7	1	7	3	9	28	9	7	8	7
ELINC	2	5	5	6	17	3	0	6	6	1	3	8	1	8	6	6	3	16	8	5	4	2	2	2	2
CAREX	0	2	0	2	0	3	0	0	0	0	0	0	0	1	0	0	1	0	0	0	4	0	0	0	3
MOSSES	24	16	29	17	65	8	34	16	17	3	25	16	15	40	16	15	11	9	14	12	51	9	1	7	0
LICHENS	5	2	7	4	4	12	7	1	4	0	3	6	0	18	2	3	2	1	7	4	2	1	4	4	0

1989 ATHABASCA	38	75	70	66	20	137	134	90	154	123	198	206	211	228	183	260	306	269	316	243	399	368	372	385	381
SHCA	12	12	6	31	2	5	11	12	0	0	11	0	15	12	29	3	0	1	2	8	4	1	4	22	13
JUCO	0	0	0	0	0	3	0	1	1	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	2
ARUV	16	24	25	26	29	37	15	27	27	27	27	42	31	33	37	33	43	40	35	31	1	45	32	43	49
LIBO	10	0	10	0	6	0	21	3	7	0	9	1	3	17	2	0	3	7	2	0	5	9	0	3	4
FRVI	1	9	5	1	0	0	1	0	3	1	1	2	0	1	1	2	1	1	0	3	0	2	4	0	1
ROAC	4	1	4	0	6	3	3	2	2	2	3	3	3	2	7	4	6	7	1	3	0	0	2	6	7
ELIN	13	25	18	21	18	14	9	27	16	15	4	12	10	6	14	21	12	7	9	7	10	2	7	6	13
MOSSES	3	4	5	3	5	1	4	3	1	1	2	1	2	3	1	2	1	1	2	1	6	4	0	3	2
LICHENS	0	0	0	0	0	1	0	1	2	0	1	1	1	1	0	1	0	1	1	0	1	1	1	1	1

1967 HECTOR	1	34	50	28	60	97	134	111	153	82	164	208	170	185	218	257	268	309	315	323	368	351	385	339
SHCA	0	0	0	1	0	2	1	0	0	1	3	1	1	0	0	2	1	1	2	0	0	4	1	1
MEFE	4	4	4	4	5	4	4	4	4	4	3	4	4	4	1	2	2	4	3	5	4	4	0	0
LIBO	0	0	1	0	0	0	0	0	0	1	1	0	1	0	1	0	2	0	2	0	0	0	1	2
VASC	2	1	1	2	1	1	1	2	2	2	3	1	1	2	1	2	2	2	1	2	2	1	2	1
VAMY	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	2	0	0	0
PELT	2	2	1	2	1	0	2	1	1	3	2	1	2	2	1	2	2	2	2	1	0	1	1	1
CLAD	2	2	3	2	2	2	2	2	3	2	2	2	1	3	3	2	2	2	1	2	2	1	1	1
PLSC	4	4	4	4	4	3	2	4	3	2	3	4	2	2	2	2	1	2	0	2	4	4	0	0
DIFO	0	1	1	0	1	1	0	0	1	1	1	1	0	1	0	1	1	0	0	1	1	1	0	1

1989 HECTOR	1	34	50	28	60	97	134	111	153	82	164	208	170	185	218	257	268	309	315	278	323	368	351	385	339
SHCA	0	2	0	4	2	2	3	0	0	3	14	0	6	0	0	10	5	8	10	0	0	0	2	3	3
MEFE	20	22	30	36	21	15	27	22	25	20	27	26	17	23	0	5	17	19	8	22	23	42	32	0	6
LIBO	0	0	2	0	0	3	1	0	0	0	0	1	5	3	3	1	1	1	2	0	0	0	0	3	7
VASC	5	8	3	4	5	11	4	9	8	6	5	7	2	9	3	3	0	5	8	5	2	5	5	10	4
VAMY	0	0	0	0	1	0	0	0	2	0	0	1	0	1	0	0	0	2	0	0	0	4	1	0	0
PELT	3	3	1	4	0	4	4	0	2	9	2	2	7	8	6	4	14	8	2	2	2	2	0	3	10
CLAD	1	3	4	1	3	3	2	8	2	6	5	0	0	6	2	1	2	5	5	2	0	3	1	3	5
PLSC	61	32	45	57	53	38	27	56	56	28	38	70	26	10	20	25	17	34	11	55	34	67	64	2	5
DIFO	6	2	1	1	0	1	2	5	4	4	2	1	1	2	4	0	0	0	0	3	0	7	0	0	3
BALY	5	2	4	4	16	1	1	3	4	6	5	1	4	1	1	3	2	2	0	6	7	6	1	2	4

APPENDIX C

SITE LOCATION INFORMATION

Athabasca

The stand lies 8.6 km south of the bridge over the Athabasca River when following Highway 93 south from Jasper town (about 15 km south of the town itself). The northern boundary of the stand is 20 to 30 m south of the southmost of the two gravel pits found to the west of the highway. The eastern boundary of the stand is 20 to 30 m from the treeline along the west side of the highway.

Whirlpool

Access to the stand can be gained from the opposite side of Highway 93A from an old gravel pit that lies 1.1 km south from the bridge across the Whirlpool River (the site is to the north of the highway while the gravel pit is to the south of the highway). The site is between 400 and 500 m from the highway and can be reached if one follows a route perpendicular to the highway. The NW corner of the site is 45 m from the river bank and the SW corner is still closer.

Sunwapta

Access from Highway 93 is 1.6 km south of the Honeymoon Lake campground and 200-300 m north of the Ranger Creek group camping turnoff (the Highway levels off here briefly in the middle of a huge hill). To the west of the highway at roughly the same elevation is a "stump graveyard" probably created at the time the highway was built. If one takes a compass bearing of 194 degrees S from the uprooted stumps and climbs down the steep embankment and travels about 80 to 100 m from the valley wall the site will be found.

Hector

Access from Highway 93 can be gained to the site 8.6 km north of the junction with the Trans Canada Highway. The highway at this location is straight and one should be about equal distant from the two nearest bends in the road. The site is located above the highway at a compass bearing of 54° NE. It is approximately 160 m from the highway (or 90 m from the old road which will be crossed en route to the site).